

Cruise report of the 2012 IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER)

KOJI MATSUOKA¹, SALLY MIZROCH², YONG-ROCK AN³, SAEKO KUMAGAI⁴ AND KIYOJI HIROSE⁵

1: *The Institute of Cetacean Research, 4-5, Toyomi, Chuo, Tokyo, 104-0055, JAPAN*

2: *Alaska Fisheries Science Center, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA, USA*

3: *Cetacean Research Institute, National Fisheries Research and Development Institute, 139-29, Maeam-Dong, Nam-Gu, Ulsan, 680-050, Republic of Korea*

4: *IWC nominated researcher, 7-54, Asakura, Yamaguchi, 753-0061, JAPAN*

5: *Kyodo Senpaku Co. LTD., Toyomi 4-5, Chuo-ku Tokyo, 104-0055, JAPAN*

Contact e-mail: matsuoka@cetacean.jp

ABSTRACT

The 3rd annual IWC-POWER (as a successor to the IWC/IDCR-SOWER cruises since 1978/79 in the Antarctic) was successfully conducted from 13 July to 10 September, 2012 in the eastern North Pacific (north of 40°N, south of the Alaska, between 150°W and 135°W) using the Japanese Research Vessel *Yushin-Maru No.3*. The cruise was organized as a joint project between the IWC and Japan. The cruise plan was endorsed at the 63rd IWC/SC meeting. Researchers from Japan, Korea and the US participated in the survey. The cruise had five main objectives: (a) provide information for the proposed future in-depth assessment of sei whales in terms of both abundance and stock structure; (b) provide information relevant to Implementation Reviews of whales (e.g. common minke whales) in terms of both abundance and stock structure; (c) provide baseline information on distribution and abundance for a poorly known area for several large whale species/populations, including those that were known to have been depleted in the past, but whose status is unclear; (d) provide biopsy samples and photo-identification photos to contribute to discussions of stock structure for several large whale species/populations, including those that were known to have been depleted in the past but whose status is unclear; (e) provide essential information for the intersessional workshop to plan for a medium-long term international programme in the North Pacific. The sighting survey was conducted under the methods based on the guidelines of the IWC/SC and the predetermined transect lines were completed. The survey effort was stratified into two zones: a northern stratum within the US and Canada Exclusive Economic Zone (EEZ) and a southern stratum south of the US and Canada EEZ. Survey coverage was 80% in the northern stratum and 85% in the southern stratum. A total of 2126.0 n.miles was surveyed in the research area in the Passing (NSP) with abeam closing mode. Sightings of blue (4 schools / 4 individuals), fin (149/210), sei (87/164), common minke (2/2), North Pacific right (1/1), humpback (21/33), sperm (50/57), Baird's beaked (1/6), Cuvier's beaked (1/4), Stejneger's beaked (2/8), Mesoplodon spp. (3/9), Ziphiidae (23/44), killer (17/99), Risso's (1/16), common dolphin (3/135), Pacific white sided dolphin (3/27), northern right whale dolphin (1/10), Dall's porpoise (132/636), and unidentified large whales (59/93) were made. Fin and sei whales were the most frequently sighted species. Blue whales were sighted in southern stratum. Fin whales were widely distributed in both strata. Except for two sightings in the Canadian EEZ, sei whales were sighted in only the southern stratum and widely distributed with some areas of concentration. A common minke whale was sighted in each strata. A solitary North Pacific right whale was sighted in the northern stratum 120 n.miles southeast of Kodiak Island, Alaska. Humpback whales were only sighted in the northern stratum. Most sperm whales were solitary large males and were sighted in both the northern and southern strata in some areas of concentration. Killer whales were sighted in both the northern and southern strata. Photo-identification data for 4 blue, 1 North Pacific right, 26 humpback, 60 fin, 51 sei and 47 killer whales were collected. A total of 52 biopsy samples from were successfully collected from 2 blue, 12 fin, 37 sei and 1 killer whale using the Larsen-gun system. Marine debris of 230 objects was recorded, including some areas of dense concentrations. The Estimated Angle and Distance Training Exercise and Experiment were completed as in previous years. The planned sighting procedure was in accordance with the guidelines agreed by the SC. As explained the objectives of the survey and its procedure to the vessel, the Captain, officers, crew and international researchers fully understood the objectives and methods for operating the survey properly before starting the survey. The 3rd cruise of this program was completed and provided information that various baleen whale species and other cetacean species were widely distributed in the research area where they were depleted in the past. These results will contribute to the above objectives for the IWC/SC.

1. INTRODUCTION

1.1 Research objective

The cruise was organized as a joint project between the IWC and Japan (IWC, 2011a, 2011b, 2012a and 2012b; Kato *et al.*, 2011, Matsuoka *et al.*, 2011, 2012). The cruise plan was endorsed at the 63rd IWC/SC meeting. The cruise had five main objectives: (a) provide information for the proposed future in-depth assessment of sei whales in terms of both abundance and stock structure; (b) provide information relevant to Implementation Reviews of whales (e.g. common minke whales) in terms of both abundance and stock structure; (c) provide baseline information on distribution and abundance for a poorly known area for several large whale species/populations, including those that were known to have been depleted in the past, but whose status is unclear; (d) provide biopsy samples and photo-identification photos to contribute to discussions of stock structure for several large whale species/populations, including those that were known to have been depleted in the past but whose status is unclear; (e) provide essential information for the intersessional workshop to plan for a medium-long term international programme in the North Pacific (IWC, 2012a).

1.2 Research area, cruise track design and priority of the cruise

The research area was set north of 40°N, south of the Alaskan coast including both the US and Canadian EEZ between 150°W-135°W (Figure 1a). The survey area is divided into northern and southern strata at the US and Canadian EEZ. Outer limit of EEZ is provided by NOAA Office of Coast Survey and the data are available from http://www.nauticalcharts.noaa.gov/csdl/docs/GIS_EEZ_Alaska.zip. A random start point for survey tracks was used as same as 2010 and 2011 IWC-POWER cruise based on the IWC/SC survey guidelines (IWC, 2005). Every location within the study area has an equal probability of being sampled which is calculated by the software “DISTANCE” (Thomas *et al.* 2010). Figure 1b shows the cruise track design in the research area and Table 1a shows the planned waypoints (WP) for the pre-determined tracklines. Research hours during the cruise were the same as on SOWER cruises. The research day began 60 minutes after sunrise and ended 60 minutes before sunset, with a maximum of a 12-hour research day. Time-zone changes were in 30-minute or 60-minute intervals, coming into effect at midnight. Primary search effort was conducted only in acceptable weather conditions. The sighting survey was conducted using Passing (NSP) with abeam closing mode based on the discussions at the Tromsø SC meeting, recommendations based on the 2010 cruise and suggestions from the SC members. The usual guidelines for acceptable conditions applied, i.e. visibility greater than 2.0 n. miles and wind speed is <21 knots; the sea state should be <Beaufort 6 as same as previous cruise. Two primary observers observed from the barrel at all times in NSP mode (See Item 2 Survey Mode). Details of the sighting survey are given in the “Information for researchers” (Anon. 2011a). In the case of sightings of very rare species (e. g. blue and right whales), the ship may conduct a direct approach to the location of the sighting if there is a possibility that the group could be lost if closing were delayed.

The R/V *Yushin-Maru No.3* (YS3) surveyed the US and Canadian EEZ first, and then surveyed the high seas area. Biopsy sampling was conducted on the high seas after YS3 exited the US and Canadian EEZ. As appropriate and decided by the Cruise Leader, research time was given for biopsy sampling of blue, North Pacific right, sei, common minke, fin, humpback, and sperm whales (Bryde’s whales are unlikely to be seen north of 40°N), with higher priority given to the former four species in this cruise using the Larsen-gun system. Biopsy of killer whales was successfully attempted on an opportunistic basis. Target species for photo-ID were blue, North Pacific right and humpback whales. Photos of fin whales, sei whales, sperm whales and killer whales were also obtained opportunistically.

An entry permit into the US and Canadian EEZ for the YS3 had been issued by the US and Canadian Governments. While in the US EEZ, the YS3 conducted research under the US National Marine Mammal Laboratory’s (NMML) MMPA/ESA (Marine Mammal Protection Act/ Endangered Species Act) Permit No. 14245-01. Sally Mizroch (US researcher on board) is a Co-Investigator on the NMML permit. Research activities within the Canadian EEZ were conducted under the Canadian License to Study Marine Mammals for Research Purposes (MML 2012-02-SARA-153) issued to Takaaki Sakamoto (Fisheries Agency of Japan) with assistants listed as cruise participants Matsuoka, An and Mizroch.

2. SHORT NARRATIVE OF THE CRUISE

2.1 The 2012 cruise itinerary

Date	Event
12 July 2012	Pre-cruise meeting
13 July	Researchers on board. Vessel depart Shioyama, Japan
24 July	Vessel arrived in the research area to the starting point at 150°00’W
30 August	Vessel completed the research at 150°00’W (38 days in the research area).

8 September	Post-cruise meeting
10 September	Vessel arrived Shiogama, Japan (researchers got off)

2.2 Research vessel used

The R/V *Yushin-Maru No.3* (742GT) was engaged for this cruise same as 2011 cruise. Details including a photo, ship specifications and a list of crew of the vessel is shown in Appendix A.

2.3 Scientists present and responsibilities

For the cruise, four researchers were selected by the steering group of this cruise, Koji Matsuoka (Cruise leader), Sally Mizroch (photo-ID and biopsy data management), Yong-Rock An (biopsy sample management/video), Saeko Kumagai (sighting and data management).

Koji Matsuoka (Japan) - Cruise Leader, sighting/photo-ID
 Sally Mizroch (USA) –photo-ID and biopsy data management
 Yong-Rock An (Republic of Korea) – biopsy sample management/video
 Saeko Kumagai (Japan) – sighting and data management
 Reserve : -

2.4 Pre-cruise meeting

On 12 July, the pre-cruise meeting was held on the R/V *Yushin-Maru No.3* (YS3) under Kato (Convenor of this cruise). In the meeting, it was discussed and confirmed on the priorities and strategies of the cruise based on the planning report (IWC, 2012b), as well as the SC64 report (IWC, 2012a). Meeting participants were: Kato (TUMSAT, Chair), Miyashita (NRIFS), Matsuoka (ICR, cruise leader), Mizroch (US, AFSC, researcher), An (Republic of Korea, CRI, researcher), Kumagai (IWC nominated researcher), Hirose (Captain), Murai (Chief Engineer), Iida (Chief Operator), Kasai (Chief Officer), Ohmura (Bosun) and Kitajima (Kyodo-Senpaku). Report of this meeting was distributed to the steering group after review by the Chair (Anon. 2012b). On 13 July, all researchers and equipment were on board the YS3.

2.5 Survey Mode

Sighting activities aboard the ship were classified into two principal types: On-effort and Off-effort. In the sightings survey portion of the research, On-effort activities were times when full search effort is being executed and conditions (such as weather and sea conditions) were within acceptable parameters to conduct research. Off-effort activities were all activities that were not On-effort. All sightings recorded while the ship was On-effort were classified as Primary sightings. All other sightings are considered to be Secondary sightings. Sighting effort was conducted by the bosun and topmen from the barrel (crow's nest) and the upper bridge where the helmsman, captain or officer-on-watch, researchers, and the chief engineer or deputy are also present. Passing with abeam closing Mode (NSP) was used during this cruise. This was in effect Passing Mode. Two topmen were observing from the barrel at all times. There was open communication between the upper bridge and the barrel. The observers on the upper bridge communicated with the topmen only to clarify information and did not direct the topmen to disrupt their normal search procedure unless they were directed to do so by the Cruise Leader (Anon. 2012a).

Immediately after a sighting was made from the barrel, the topman informed the upper bridge of his estimate of the distance and angle to the sighting (and also, if possible, the species and number of animals present), but did not change his normal searching pattern in order to keep contact with the sighting. The observers on the upper bridge attempted to locate the sighting made by the topman and decided whether it was possible for them to confirm the species and number before the sighting passes abeam of the vessel. The topman gave no further information to the upper bridge unless the whale group happens to surface again within the normal searching pattern of the topman. A designated researcher on the upper bridge recorded the species and estimated number of whales in the school when the sighting passed abeam of the vessel, in consultation with other researchers. When the sighting location was abeam of the vessel, the ship changed course to the appropriate heading to approach the whale, and vessel speed was increased to 15 knots to hasten the closure. Ship speed was decreased when the group is neared, usually at a distance of 0.2-0.4 n. miles from the initial sighting position. After the whale group was approached, the species, number of animals in the group, estimated lengths, number of calves present, and behaviour are determined and recorded. After as much data as possible have been collected, other activities might take place, such as natural marking or biopsy experiments. Until the ship resumed the transect with full search effort, any whale sightings made after the initial sighting were classified as secondary sightings (Anon. 2012a).

2.6 Weather conditions and expected versus realised effort

Weather conditions were different and better than in the previous two cruises. In both northern and southern strata, general weather conditions were good due to a strong high pressure system and high sea surface temperature from the

Alaskan gyre current from the south. A total of 2,126.0 n. miles (767.5 n. miles in the northern stratum and 1,358.5 n. miles in the southern stratum) was surveyed in the research area in the Passing (NSP) with abeam closing mode. Survey coverage (searching distance / planned distance) was 80% in the northern stratum and 85% in the southern stratum.

3. SUMMARY OF SIGHTINGS

3.1 Identification of species

Guidelines for species identification were based on the IWC-SOWER (Southern Ocean Whale and Ecosystem Research) and IWC-POWER methods for classification of identification (Anon, 2012a):

Positive identification of species was based on multiple cues and usually required the clear observation of the whale's body. Occasionally, repeated observations of the shape of the blow, surfacing and other behavioural patterns were also sufficient; this judgement was made only by the Chief Scientist or other designated researcher. Probable identification of species was based on multiple cues, which were nevertheless insufficient to be absolutely confident in identification. This usually occurred when blows are seen, the surfacing pattern is correct, but the whale's body could not be seen or clearly seen.

3.2 Determination of group size

The following guidelines were used in determining group size: Schools where the number of animals, or an accurate estimated range of the number of animals, was determined were classified as confirmed schools. The data from the confirmed schools can be used to determine a mean school size. Therefore it is critical that the schools that are confirmed are representative in size of the schools that are in the survey area. Normally, schools believed to be confirmed for school size are approached to within 1n. mile for large whales and to within 0.3 n. miles for minke whales. Obviously, there are differences in the environmental conditions and behavior of the animals for every sighting; however, (with particular reference to minke whale sightings) every effort was made to be as consistent as possible in regard to the maximum time spent on identification of species and confirmation of numbers. Normally, if the sighting was thought to be minke whales, no more than 20 minutes (after closure has been completed) should be spent trying to complete these tasks. (Otherwise there is the potential for confusion with other sightings in the vicinity) (Anon, 2012a).

3.3 Sighting summary

Tabulations of all waypoint (WP) of the track line, the searching effort and the sightings recorded in the northern and southern strata, by species and by effort mode are presented in Tables 1a, 1b and 2a, 2b, respectively. Table 2c lists the sightings observed during transit to and from the research area. Table 2d summarizes all the sightings observed during the entire cruise. Table 3 shows the sea surface temperatures (min. max. and range) for each species sighted in the research area and provides quartile analysis for a few of the major species observed. Figure 1b and 1c illustrates the track line design and location of the searching effort, respectively. Figures 2a and 2b illustrates the location of the sightings. Figure 3 shows the breakdown of research time, in minutes with the strata of the research area.

Transit survey to the research area (Including US EEZ)

The YS3 departed Shioyama port on schedule (09:50, 13 July) and started transit survey using the passing mode between 15 July (06:00) and 24 July (13:03) from Shioyama to the research area under good weather or intervals of rain/fog conditions. The YS3 entered the USEEZ at position 48°07'N 177°24'E on 19 July 12:53. Fin and sei whales were sighted in the eastern side of the Adams sea mount (50°N, between 176°W and 175°W) on 20 July including a mixed group of fin and sei whales (Appendix Figures 1, 2 and 3). A number of fin and humpback whales were sighted during transit along the Aleutian trench (53°N, between 163°W and 162°W) on 22 July (Appendix Figures 2 and 3). Total searching distance was 550.5 n. miles. Total sightings included fin (35 schools / 41 individuals), sei (6/13), humpback (14/26), sperm (5/5) Baird's beaked (1/6), Ziphiidae (1/2), killer (5/57) whales, common dolphin (1/30) and Dall's porpoise (5/35) including mother and calf groups of fin (1), sei (1), humpback and killer (6) whales. Sightings recorded in the transit sighting survey, by species are presented in Tables 2d. Photo-identification data were collected for nine fin whales, 5 sei whales, 19 humpback whales, and 21 killer whales during the transit survey (Table 4).

Northern stratum (US and Canadian EEZ)

The YS3 finished the transit survey and started the research area survey in the US EEZ approximately 120 n. miles southeast of Kodiak Island at Waypoint 101 (WP, see Table 1a) position 55°47'N 150°00'E on 24 July 13:03 on a northeast course under acceptable searching conditions. The YS3 arrived at the northernmost WP (WP105) on 27 July 13:25 south of the eastern side of the Bering Glacier and turned to the southeast on schedule. The YS3 departed the US EEZ and entered the Canadian EEZ on 1 August at 12:29 at position 53°43'N, 137°22'W, and departed the Canadian EEZ to the high seas on 3 August at 11:40 at position 50°28'N, 136°12'W.

A solitary North Pacific right whale was sighted in the northern stratum at 56°17.5'N 149°10.7'E on 24 July (Figure 2a, Appendix Figure 3a). Estimated body length was 14.3 meters. A number of fin whales were sighted every day during 24 to 29 July and were widely distributed in the northern research area (55-60°N, between 150°W and 140°W, Figure 2a). Four fin whale mothers and calves were sighted (Appendix Figure 1). One fin whale mother was photo-identified. There were sightings of 17 groups of fin whales on 30 July and at least one or two groups of fin whales sighted each day after that. Fin whales were widely distributed in the northern research area (60°N -50°N, between 140°W and 135°W). Two mixed groups of fin and sei whales in the Canadian EEZ, including a fin whale mother and calf were sighted. Dall's porpoise were observed probably feeding in the vicinity of fin whales and a mixed group of fin and sei whales. Directed photo-ID approaches were conducted for one humpback whale in the US EEZ, two sei whales in the Canadian EEZ and a group of 3 killer whales in the Canadian EEZ.

Total searching distance was 767.5 n. miles in the northern stratum (579 n. miles in the US EEZ and 188.5 n. miles in the Canadian EEZ). Survey coverage of the northern stratum (total searching distance / planned cruise track distance) was 79.9 %. Total sightings included fin (76 schools /116 individuals) including 5 calves, sei (2/4), common minke (1/1), North Pacific right (1/1), humpback (7/7), sperm (17/24), Mesoplodon spp. (2/5), Ziphiidae (9/15), killer (8/22) whales, Pacific white-sided dolphin (1/7) and Dall's porpoise (68/248) including mother and calf groups of fin whales (5). Sightings recorded in the northern stratum, by species, survey modes are presented in Tables 2a. Photo-identification data were collected for the North Pacific right, 36 fin whales, 3 sei whales seven humpback whales, one sperm whale and 12 killer whales in the northern stratum (Table 4).

Southern stratum

The YS3 started the southern stratum (high seas) survey at Waypoint 121 (Table 1b) position 50°28'N 136°12'E on 3 August 11:40 on a southwest course towards 40°N under heavy fog intervals. The YS3 turned at 40°N to the northwest course under good weather conditions. Total searching distance of the southern stratum was 1,358.5 n. miles and survey coverage (searching distance / planned distance) was 85.0 % in the southern stratum.

The most dominant species in the southern stratum were sei (79 schools / 147 individuals including 6 calves) and fin (38/53 including 4 calves) whales (Figures 2a, Appendix Figures 2 and 3a). There were sightings of 14 schools (26 individuals) of sei whales on 10 August during western side of the Kagami seamount between 47°N-45°N and 137°W-139°W. Two mixed groups of fin and sei whales (surfacing together as if conspecifics) were seen and a third group where fin and sei whales were feeding near each other (Appendix Figure 1). We also saw three sei whale mothers and calves during surveys of the southern stratum. There were sightings of 18 schools (38 individuals) of sei whales on 12 and 13 August along the western side of the Raff seamount between 45°N-42°N and 139°W-141°W. Three mixed groups of fin and sei whales (surfacing together as if conspecifics) were approached and biopsy samples were obtained from both fin and sei whales on two occasions and from the sei whale only on one occasion (Appendix Figure 5). Two sei whale mothers and calves (biopsy samples from one mother and calf group) and two fin whale mothers and calves were also observed.

A total of 4 groups (4 individuals) of blue whales were observed in the only western part of the southern stratum (Figure 2a). All blue whales sighted were solitary.

Total sightings included blue (4 schools /4 individuals), fin (38/53), sei (79/147), common minke (1/1), sperm (28/28), Cuvier's beaked (1/4), Stejneger's beaked (2/8), *Mesoplodon* spp. (1/4), Ziphiidae (13/27), killer (4/20) whales, Risso's (1/16), common dolphin (2/105), Pacific white-sided dolphin (2/20), Northern right whale dolphin (1/10) and Dall's porpoise (59/353) including mother and calf groups of fin (4) and sei (6) whales. Sightings recorded in the northern stratum, by species, survey modes are presented in Tables 2b. Photo-identification data were collected for four blue whales, 16 fin whales, 43 sei whales and 14 killer whales in the southern stratum (Table 4). A total of 52 biopsy samples from fast swimming whale species were successfully collected from 2 blue, 12 fin, 37 sei and 1 killer whale (Table 5).

Transit survey to Shiogama (Including US EEZ)

Sighting surveys were not conducted during transit from the research area to Shiogama between 30 August (8:46) and 5 September (16:40) until 170E because of areas of heavy wind (Table 1c). No sightings were recorded in the transit sighting surveys from research area to Shiogama (Tables 2d).

Detailed sightings by each species as follows:

Blue whale

A solitary blue whale was sighted on 18 August at 45°36'N, 139°52'W (sea surface temperature was 16.2°C) and estimated body length was 23.2 m. A solitary blue whale was sighted on 23 August at 49°56'N, 147°15'W (sea surface temperature was 12.6°C) and estimated body length was 22.3 m. Two different solitary blue whales were sighted on 18 August at 52°17'N, 148°41'W (sea surface temperature was 11.2°C) and at 52°35'N, 148°52'W (sea surface temperature

was 11.3°C) estimated body lengths were 23.8 m and 23.2 m, respectively. . Dall's porpoise were swimming near the first blue whale seen on 29 August, which is similar what was observed with fin, sei and humpback whales

Sea surface temperatures of the sightings ranged from 11.2°C to 16.2°C. Blue whales are rarely seen on the high seas and their oceanic distribution is poorly understood. The sightings data, biopsy samples and photo-identification data collected during this cruise will allow researchers to begin to assess abundance and study stock structure and movements of this species.

Fin whale

Fin whales were the most frequently encountered baleen whale species in the research area (Figure 2a, Appendix Figure 2). Fin whales were widely distributed in the northern and southern strata and there were some concentrated areas in both northern and southern stratum (Figure 2b). A total of 149 schools (210 individuals including 10 calves) of fin whales were observed through the surveys. Sea surface temperatures ranged from 7.8°C to 22.5°C but the majority of sightings were within 10.3-13.2 °C (25th to 75th quartiles) (Table 3, Figure 4). Biopsy samples were obtained from 12 fin whales, including from both mother and calf (Appendix Figure 5).

Sei whale

Although sei whales were the second frequently encountered baleen whale species through the surveys, almost all sei whale sightings were in the southern stratum (Figure 2a). Sei whales were observed in the US EEZ on only one day (See Appendix B) and were observed on 2 different days in the Canadian EEZ (See Appendix C). A total of 87 schools (1647 individuals, including 7 calves) of sei whales were observed. Biopsy samples were obtained from 37 individuals, including a mother and calf. Sei whales were seen mostly in groups of one (62%, 36 sightings) and groups of two (24%, 24 sightings). Sea surface temperatures ranged from 7.8 °C to 22.5°C, the same overall range as fin whales, but the majority of sei whale sightings were within a temperature range of 14.5 to 18.9 °C, a much higher than fin whales (Table 3, Figure 4).

Mixed groups of fin and sei whales

Sei and fin whales were observed in mixed groups on six occasions, including one sighting with fin and sei and Dall's porpoise feeding in the same area (Appendix Figure 1). For four of the six encounters, sei and fin whales were surfacing like conspecifics. In the other two sightings, it was unclear if the sei and fin whales were together or were feeding on the same prey patch. One mixed group sighting was in the US EEZ before entering the research area, two sightings were in the Canadian EEZ, and the others were in the southern stratum (Appendix Figure 1). Biopsy samples were collected from both fin and sei whales on two occasions and only the sei whale on one occasion (Appendix Figures 1 and 5).

Dall's porpoise observed feeding near large whales

Dall's porpoise were observed in all but the most southern regions of the research area (Figure 2b, Appendix Figure 5). They were observed feeding in the vicinity of large whales 13 times (Appendix Figure 1). Dall's porpoise were observed near 2 blue whales, 8 fin whale groups, one sei whale group, one humpback group, and one mixed group of fin and sei whales.

Common minke whale

A total of 2 schools (2 individuals) of common minke whales were observed, one observation in each in both strata. Both observations occurred under very good sighting conditions, i.e., sea state 1 or 2 (Figure 2a). Common minke whales were observed at sea surface temperature from 13.4°C to 14.1°C. Because of difficulty in seeing their blow and small body, observations of this species were more difficult than in Antarctic waters. Common minke whales are hard to find within harsh sea surface conditions because their blows are not visible.

North Pacific right whale

A solitary North Pacific right whale was sighted in the transit survey at 56°17.5'N 149°10.7'E on 24 July (Figure 2a, Appendix Figure 3b). Sea surface temperature at the sighting position was 10.0°C. Estimated body length was 14.3 meter. The population of North Pacific right whales is severely depleted and rarely seen in the eastern North Pacific. Photographs were compared with NMML's North Pacific right whale catalog and there is the possibility that this is a newly documented. The sighting location is in the vicinity of the locations of illegal Soviet right whale catches from the 1960s (Ivashchenko and Clapham, pers. comm.)

Humpback whale

Humpback whales were the third most frequently encountered baleen whale species but all sightings of humpback whales were either during transit, in the northern stratum, or off effort near the southern boundary of the US EEZ (Appendix Figure 3b). A total of 21 schools (33 individuals including a mother and calf) were seen. Humpbacks sightings began

during transit along the Aleutian trench at around 170° W. Of the 21 sightings, 14 occurred during transit to the research area and 7 occurred in the northern stratum of the research area. Group sizes ranged from 1 to 5 along the Aleutian trench, including the mother/calf sighting. All humpback whales sighted east of 159° W were solitary individuals. After research in the southern stratum was completed, a solitary humpback whale was observed off effort in the southern part of the US EEZ as the return transit began (Appendix Figure 3b). Humpback whales were observed in sea surface temperatures ranging from 8.5°C to 12.6°C and the majority of sightings were between 8.6-10.5 °C, a much narrower band of temperatures than observed for fin and sei whales (Table 3, Figure 4).

Sperm whale

A total of 50 sperm whale schools (57 individuals) were seen over a wide area (Figure 2b, Appendix Figure 6). Sperm whales were observed at sea surface temperature ranges from 7.7°C to 20.8°C and the 25th to 75th quartile range was 11-14.0 (Table 3). Sperm whales were the most frequently encountered toothed whale species in the research area (Figure 2b, Appendix Figure 6). Most sperm whales were solitary large males (97% of the schools) and were widely distributed in the northern and southern strata in some concentrated areas near the eastern shelf edge in the northern stratum (Figure 2b). No sperm whale females or calves were sighted during the survey.

Ziphiidae and *Mesoplodon* spp.

One school (6 individuals) of Baird's beaked whale was seen during the transit to the research area (sea surface temperature ranged from 11.2°C). One school (4 individuals) of Cuvier's beaked whale was seen in the research area (sea surface temperature ranged from 13.9°C). A total of 23 schools (44 individuals) of unidentified Ziphiidae were observed (sea surface temperature ranged from 10.0°C to 21.4°C). A total of 3 schools (9 individuals) of unidentified *Mesoplodon* species were observed in the research area (sea surface temperature were from 17.9°C to 20.6°C). They were widely distributed throughout the research area (Figure 2d).

Killer whale

A total of 17 pods (99 individuals including 7 calves) of killer whales were observed during the cruise (Figures 2b, Appendix Figures 3a and 3b). The westernmost sighting (approx. 152° E) was a pod of 23 individuals which were observed in an area where the sea surface temperature was 19° C. The overall range of sea surface temperatures where killer whales were observed was 9.2°C to 19.0°C, but most sightings were at a range of 10.3 to 13.6 (Table 3). Killer whales were sighted during transit and in both the northern and southern strata (Appendix Figures 3a and 3b). Photo-identification catalogue numbers were assigned to 47 individuals (Table 4). Mothers and calves were observed and photo-identified in two different pods. One biopsy sample was collected opportunistically.

One killer whale pod (n = 4) was observed twice in one day. The pod was encountered firstly in the morning of 27 July on the way to the northernmost waypoint. The same pod was encountered nine hours later during the southbound transit. All four individuals were photo-identified during each encounter. Based on precise location data from the geocoded photographs of the whales during each encounter (latitude and longitude encoded in the photo EXIF metadata), the whales had traveled 33.9 miles at a bearing of 91° from the first sighting. Speed of travel was estimated at 3.8 knots.

Other species

Sightings of dolphin species such as short-beaked common dolphin (3 schools 135 individuals), Pacific white-sided dolphin (3/27), Northern right whale dolphin (1/10), Risso's dolphin (1/16), Dall's type Dall's porpoise (93/481), Unidentified type Dall's porpoise (39/155) were made. Dall's porpoise were the most frequently encountered dolphin species. This species was sighted throughout the research area (Figure 2b). There were 3 instances where Dall's porpoises were probably feeding in the vicinity of fin whales on 27 August and one instance where Dall's porpoises were feeding in the vicinity of a blue whale on 18 August.

4. PHOTO-IDENTIFICATION

A total of four blue whales, 60 fin whales, 51 sei whales, 26 humpback whales, one sperm whale and 37 killer whales were photo-identified during the 2012 IWC-POWER cruise (Table 4). Catalogue numbers were assigned to all species but fin whales during the research cruise. Fin whales were not assigned catalogue numbers due to time constraints.

During transit to the research area, photo-identification data were collected for 9 fin whales, 5 sei whales, 19 humpback whales, and 21 killer whales. In the northern stratum, where biopsy sampling was not permitted, photo-identification data were collected for the North Pacific right whale, 36 fin whales, 3 sei whales, 7 humpback whales, one sperm whale and 12 killer whales. In the southern stratum, photo-identification data were collected for four blue whales, 16 fin whales, 43 sei whales and 14 killer whales.

5. BIOPSY SAMPLING

A total of 52 biopsy samples were collected, including 2 blue whales, 12 fin whales, 37 sei whales, and 1 killer whale (Table 5, Appendix figure 5). Every biopsy encounter was documented photographically.

5.1 Biopsy data management

Biopsy darts were numbered and color-coded and each biopsy shooter used either red or black labeled darts. During setup for each biopsy sampling encounter, photos were taken of each dart before it was loaded into the Larsen gun. After a sample was collected, photos were taken of each dart with the sample. This allowed us to track which whale was sampled. The time of each biopsy hit was captured photographically (including for the biopsy event that wasn't photographed), and the biopsy time was written on the foil wrap for each sample before it was taken to the biopsy lab. The biopsy time was also recorded for each sighting by the researcher on the upper bridge.

Each evening, the photos were evaluated to confirm which whale had been biopsied. After analysis of the photographs, biopsy sample numbers were assigned and simultaneously linked to photo-ID data were possible. Information about each encounter was entered into the PhotoID_Biopsy database. Sighting number, photo-ID and biopsy data were recorded in each photo's EXIF metadata fields.

After sample numbers were assigned, data were double-checked with the sightings records to confirm sighting numbers and biopsy hit times, and then biopsy data sheets were given to the biopsy sample manager for sample processing.

Times of biopsy start (setup on bow deck, document biopsy darts before approach), hitting, retrieval (photo of dart with sample) and/or finish (no hit or no shot) were recorded in the "PhotoID_Biopsy database" based on time of the photos:

5.2 Biopsy efficiency

Biopsy duration times were evaluated to examine biopsy efficiency (Table 5a, Figures 5a and 5b). There were 77 encounters where biopsy sampling was attempted. Of those, 48 encounters resulted in a successful hit. For 12 encounters, shots were fired but no whales were sampled. For 17 encounters, the biopsy team was ready on the bow deck but no shots were fired.

In 75% of the 48 successful biopsy encounters, the first hit occurred in less than 17 minutes from biopsy setup (Table 5a). The fastest time to first hit was less than 3 minutes. For encounters where no shots were fired, 75% of encounters ended in less than 33 minutes (Table 5a). Where shots were fired but no samples obtained, 75% of those encounters ended in less than 23 minutes (Table 5a).

Some of the encounters of very short duration occurred under ideal sighting conditions, i.e., good lighting and calm seas, where the topmen could track the whales underwater as we approached. Most of the encounters where no shots were fired were approaches to whales which were surfacing in erratic (not predictable patterns) under less than ideal lighting conditions.

Table 5b shows the summary of biopsy experiment. Biopsy sampling was attempted as often as possible in the southern stratum.

6. VIDEO-RECORDING

Video recording was opportunistically conducted in this cruise. Video of the main sightings were recorded for the behavioral studies of cetacean animals and the backup data for school size estimation or photo-id studies. The DSLR (Digital Single Lens Reflex) camera (Samsung NX200) with 18-200mm lens was used for the video recording. The video format was MPEG-4 (Moving Picture Expert Group) with full HD (High Definition, 1920*1082 pixels) level resolution and 30 frames per seconds. Video recording took place at the bow deck during the photo-id or biopsy sampling or at the upper bridge during sighting survey.

Generally several video clips were made for each sighting because the camera was turned on and off repeatedly due to the diving behaviors of the animals. Therefore the original video clips need amount of data storage. After recording, the original clips of a sighting were edited with useful parts which the animals featured in and saved as a WMV (Windows Media Video) format in order to reduce the data storage and to provide easy access to the scenes of the animals. During the survey period, video for a Pacific right, 15 humpback, 3 blue, 55 fin, 36 sei, a common minke, a sperm and 9 killer whale sightings were recorded.

7. OTHER EXPERIMENTS

7.1 Estimated Angle and Distance Training Exercise

The Estimated Angle and Distance Training Exercise were conducted in the afternoon of 22 July for 1:44 hours. During the exercise the observers familiarized themselves with distance estimates from the TOP and Upper Bridge.

7.2 Estimated Angle and Distance Experiment

The Estimated Angle and Distance Experiment were conducted on 14 August for 4:18 hours. An Estimated Angle and Distance Training Exercise and Estimated Angle and Distance Experiment were performed using the same protocol as during recent cruises (Anon. 2010b).

7.3 Marine debris observation

During this cruise, we collected data on floating marine debris (mainly artificial materials which listed in the research manual, Anon, 2010b) to document the type and extent of the marine debris in the North Pacific (Table 9a). Special consideration was taken to try to evaluate whether any observed debris could be related to the Japan Tsunami, and a new data form was designed to help experts determine origin of debris during post-processing.

A total of 230 marine debris items were observed during transit and within the research area (Table 9a, Appendix Figure 7). During the survey, there were two areas where marine debris observations were clustered. More than 5 debris items per day were observed in late July (25-30) as we were in the vicinity of the northernmost waypoint in the northern stratum. The debris observed were a roughly equal mix of natural debris (mostly logs) and manmade (total items observed = 31) (Table 9b).

Very dense debris was observed from 13-17 August (total items observed = 171, Table 9b) as near the southernmost waypoint in the southern stratum. Most of the debris observed near the southernmost waypoint was manmade. Debris on the southward transit was observed starting at about 43° 44' N and 143° 53' W. Debris density increased at about 40° 45' N and 141° 37' W just before the southernmost waypoint and remained dense at the start of the northbound transit until about 42° 37' N and 143° 18' W.

In the area of high density in the southern stratum, 72 single fishing floats (mostly black or orange) were observed, as well as some pieces of Styrofoam, about 10 different pieces of milled wood in various states of decay, 12 tires in various states of decay, including 3 tires with rims, a cluster of fishing floats with a tangled fishing net (fairly recent) and a cluster of buoys and materials (also fairly recent) that appeared to have originated at a fish farm. There were also observations of a metal drum, and a couple of compressed air canisters.

Throughout the cruise, weekly summaries of marine debris observations were provided to Fisheries Agency of Japan and to marine debris and Japan Tsunami debris research collaborators at NOAA and GOJ. A bilingual marine debris database was developed and includes hyperlinks to photographs taken of 97 of the 230 observations. Copies of the marine debris database including hyperlinked photos of debris will be provided to marine debris specialists upon request.

8. TECHNICAL MATTERS OF DATA AND RECOMMENDATIONS

8.1 Whale ID numbering protocol for the IWC-POWER cruises

YS3 Whale ID numbers were assigned to 4 blue whales, 26 humpback whales, 51 sei whales and 47 killer whales identified during the 2012 IWC-POWER cruise. This year, the YS3 whale ID numbers have the prefix 2012. In 2011, Whale ID numbers were assigned to 9 blue whales, 28 humpback whales, 26 sei whales and 19 killer whales. Once all 2012 photos are compared to the 2011 YS3 catalog, permanent IWC-POWER whale ID numbers will be assigned, sequentially using the 2011 YS3 ID numbers as the catalog starting numbers. When photos from the 2010 IWC-POWER are cataloged, they will also be integrated into the IWC-POWER catalog.

Biopsy sample numbers have been added to the whale ID numbers when a sampled whale was photo-identified, e.g., 2012_Sei_12_12041001. For whales which have been cataloged, such as sei whales, if the whale was biopsied but not photo-identified, the whale ID number is the species, the letter "X" in place of the whale ID number, and the biopsy sample number. E.g., Sei_X_12041023. The prefix "2012" is not used in this case because the coding for the biopsy sample number includes the year "12" as part of the biopsy sample numbering protocol.

As is standard practice with killer whale identification numbering, pod ID numbers have been assigned to killer whales as well as individual whale ID numbers within each pod. The pod ID number is a unique identifier that includes the date and sighting number of the first sighting of the pod. E.g., the killer whale pod seen twice on 27 July has been assigned pod number 727_1, based on the date and sighting number of the first sighting of the pod. The ID numbers for the whales resighted later in the day use the 727_1 pod number.

In 2012, there were 60 individual fin whales photo-documented (photos of sufficient quality to compare for matching), but catalog numbers have not yet been assigned to fin whales due to time constraints. For fin whales which have been biopsied, the fin whale ID numbers contain the biopsy sample number and an uppercase “X” in place of the catalogue number. When the fin whales have been cataloged, the “X” will be replaced by the catalog number for whales which have been photo-identified.

8.2 Recommendation

It is recommended that the photo-ID photos from the 2010 IWC-POWER cruise be cataloged and integrated into the IWC-POWER catalog as soon as possible to allow them to be compared to other photo catalogs in the North Pacific in a timely fashion.

It is also recommended that recording opportunistic sightings of species of special note be considered when the sighting time occurs outside of the usual range of effort times. For example, a humpback whale was observed near the southern boundary of the US EEZ at 05:38 (before the official start of the survey effort) and therefore could not be added to the sighting record (Appendix Figure 3b). Pelagic distribution of humpback whales is poorly known and the sighting was recorded only for inclusion in the US EEZ report and will also be reported to the NMFS permit office when NMML’s annual permit report is filed.

9. CONCLUSIONS

The 3rd annual IWC-POWER (as a successor to the IWC/IDCR-SOWER cruises since 1978/79 in the Antarctic) was successfully conducted using the Japanese Research Vessel *Yushin-Maru No.3*. All equipment and the survey method were same as the past IWC international sighting surveys. The planned sighting procedure was in accordance with the guideline agreed by the SC (IWC, 2005). As explained the objectives of the survey and its procedure to the vessel, the Captain, officers, crew and international researchers fully understood the objectives and methods for operating the survey properly before starting the survey. (Sighting data was already sent to the IWC secretary and confirmed at 4th April 2013). The 3rd cruise of this program was completed and provided information (sightings and photo-ID data, and biopsy samples) that various baleen whale species and other cetacean species were widely distributed in the research area where they were depleted in the past. These results will contribute to the above objectives for the IWC/SC.

ACKNOWLEDGEMENTS

We acknowledge the Governments of the US, Canada, Republic of Korea and Japan for their assistance in the research permit and funding for this cruise. We also thank the Captain and his officers and crew of the R/V *Yushin-Maru No.3* for their hard work and dedication, which led to the successful execution of this cruise. We acknowledge Greg Donovan of the Secretariat of the IWC, the steering group of this cruise (Hidehiro Kato (Convener), Robert Brownell, Phillip Clapham, Paul Ensor, Tomio Miyashita, Hiroto Murase, Luis Pastene and Lars Walloe), the Technical advisory group of this cruise (Toshihide Kitakado, Sharon Hedley, Mark Bravington, and Nataly Kelly) and the staff of The Institute of Cetacean Research (Tokyo) and Kyodo Senpaku Co. LTD. for their assistance in arrangements and support for the cruise. The National Research Institute of Far Seas Fisheries (Yokohama) loaned equipment for the cruise, including video camera and items for biopsy processing and storage. The US Alaskan Fisheries Science Center (AFSC) also loaned camera for the experiments. Quartermasters Y. Sekine and K. Maehashi assisted with collection of biopsy samples.

REFERENCE

- Anon. 2012a. 2012 IWC-POWER Information for Researchers. 54pp. Available from the IWC Secretariat.
- Anon. 2012b. Report of the pre-cruise meeting for the 2012 IWC-POWER. 8pp. Available from the IWC Secretariat.
- IWC. 2005. Report of the Scientific Committee. Annex D. Report of the sub-committee on the Revised Management Procedure. Appendix 3. Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme. *J. Cetacean Res. Manage.* (Suppl.) 7:92-101.
- IWC. 2011a. Report of the Intersessional Meeting on the North Pacific Survey Programme. Tokyo 27-28 September 2009. *J. Cetacean Res. Manage.* (Suppl.) 12:415-420.
- IWC, 2011b. Report of the Scientific Committee. IWC/63/AnnexG.
- IWC. 2012a. Report of the Technical Advisory Group (TAG) meeting on the short and medium term objectives and plans for the IWC-POWER cruises. Tokyo 26-28 September 2011. *J. Cetacean Res. Manage.* (Suppl.) 13:xxx-xxx. (15pp).
- IWC. 2012b. Report of the Planning Meeting for the 2012 IWC-POWER Cruise. Tokyo 29-30 September 2011. *J. Cetacean Res. Manage.* (Suppl.) 13:xxx-xxx. (12pp).

- Kato, H., An, Y.R, Bravington, M., Brownell, B., Clapham, P., Donovan, G., Ensor, P., Matsuoka, K., Miyashita,, Murase, and Walløe. 2011. Research plan for the 2012 IWC / Japan Joint Cetacean Sighting Survey Cruise in the North Pacific. SC/63/O7. 12pp.
- Matsuoka, K, Hakala, S., Kim, H.W., Aki, M. and Shinyasaki, Y. 2011. 2010 IWC/Japan Joint Cetacean Sighting Survey Cruise in the North Pacific. 40pp.
- Matsuoka, K, Mizroch, S., and Komiya, H. 2012. Cruise report of the 2011 IWC-Pacific Ocean Whale and Ecosystem Research (IWC-POWER). 27pp.
- Thomas, L., S.T. Buckland, E.A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R.B. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology* 47: 5-14.

Table 1a. Way Points (WP) in the northern strata.

WP	Latitude	Longitude
101	55°46.8'N	150°00.0'W
102	56°50.1'N	148°17.8'W
103	57°53.4'N	146°32.8'W
104	58°56.7'N	144°44.5'W
105	60°00.0'N	142°53.0'W
106	58°50.2'N	141°47.3'W
107	57°40.4'N	140°43.8'W
108	56°30.6'N	139°42.3'W
109	55°20.8'N	138°42.6'W
110	54°11.0'N	137°44.6'W
111	53°01.1'N	136°48.3'W
112	51°51.3'N	135°53.5'W
113	50°41.4'N	135°00.0'W

Table 1b. Way Points (WP) in the southern strata.

WP	Latitude	Longitude
121	50°27.9'N	136°11.5'W
122	49°27.1'N	136°48.2'W
123	48°06.1'N	137°36.0'W
124	46°45.1'N	138°22.7'W
125	45°24.1'N	139°08.1'W
126	44°03.1'N	139°52.5'W
127	42°42.1'N	140°35.9'W
128	41°21.0'N	141°18.4'W
129	40°00.0'N	142°00.0'W
130	41°24.8'N	142°41.9'W
131	42°49.5'N	143°24.7'W
132	44°14.2'N	144°08.5'W
133	45°38.9'N	144°53.4'W
134	47°03.5'N	145°39.4'W
135	48°28.2'N	146°26.6'W
136	49°52.8'N	147°15.2'W
137	51°17.4'N	148°05.2'W
138	52°42.0'N	148°56.7'W
139	54°06.6'N	149°50.0'W

Table 1c. Summary of search effort (time and distance) and experimental time (hours) conducted during the 2012 IWC-POWER Cruise.

Area	Start	End	NSP with abeam closing		Photo-ID, Biopsy	Estimated angle and distance training and experiment
	Date	Date	Time	Dist.	Time	Time
	Time	Time	(hours)	(n.m.)	(hours)	(hours)
Shiogama to research area	15-Jul. 6:00	24-Jul. 13:03	46:37:40	550.50	7:10	0:00
Northern stratum	24-Jul. 13:03	3-Aug. 7:52	65:00:35	767.52	3:42	1:44
Southern stratum	3-Aug. 11:40	30-Aug. 8:46	116:54:55	1358.54	28:33	4:17
Research area to Shiogama	30-Aug. 8:46	8-Sep. 16:40	0:00	0.00	0:00	0:00
Total	15-Jul. 6:00	8-Sep. 16:40	228:33:10	2676.56	39:26:19	6:02:27

Table 2a. Number of sightings for all species observed in the northern stratum (US and Canadian EEZ) by effort mode (NSP: Normal Passing with abeam closing Mode; BX: Begin experiment; OE: Off effort). Parentheses indicate the number of calves observed.

Species	NSP		BX		OE		Total	
	Sch.	Ind	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Fin whale	73	112(5)	1	1	2	3	76	116(5)
Sei whale	2	4	-	-	-	-	2	4
Common minke whale	1	1	-	-	-	-	1	1
North Pacific right whale	1	1	-	-	-	-	1	1
Humpback whale	7	7	-	-	-	-	7	7
Sperm whale	17	24	-	-	-	-	17	24
<i>Mesoplodon</i> spp.	2	5	-	-	-	-	2	5
Ziphiidae	9	15	-	-	-	-	9	15
Killer whale	8	22	-	-	-	-	8	22
Pacific white-sided dolphin	1	7	-	-	-	-	-	-
Dalli-type Dall's porpoise	42	156	1	3	5	18(1)	48	177(1)
Unid. type Dall's porpoise	16	53	1	7	3	11	20	71
Unid. large whale	16	21	1	1	1	1	18	23
Unid. whale	1	1	-	-	-	-	-	-
Total	196	429(5)	4	12	11	33(1)	211	474(6)

Table 2b. Number of sightings for all species observed in the southern stratum by effort mode (NSP: Normal Passing with abeam closing Mode; BX: Begin experiment; OE: Off effort). Parentheses indicate the number of calves observed.

Species	NSP		BX		OE		Total	
	Sch.	Ind	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Blue whale	3	3	-	-	1	1	4	4
Fin whale	36	51(4)	-	-	2	2	38	53(4)
Sei whale	77	144(6)	1	2	1	1	79	147(6)
Common minke whale	1	1	-	-	-	-	1	1
Sperm whale	27	27	1	1	-	-	28	28
Cuvier's beaked whale	-	-	-	-	1	4	1	4
Stejneger's beaked whale	2	8	-	-	-	-	2	8
<i>Mesoplodon</i> spp.	1	4	-	-	-	-	1	4
Ziphiidae	11	23	-	-	2	4	13	27
Killer whale	3	18(1)	-	-	1	2	4	20(1)
Risso's dolphin	1	16	-	-	-	-	1	16
Common dolphin	1	25(3)	1	80	-	-	2	105(3)
Pacific white-sided dolphin	1	2	-	-	1	18	2	20
Northern right whale dolphin	1	10	-	-	-	-	1	10
Dalli-type Dall's porpoise	30	143	6	55	8	98	44	296
Unid. type Dall's porpoise	11	31	3	11	1	15	15	57
Unid. large whale	23	39	2	4	1	4	26	47
Unid. dolphin/porpoise	8	207	-	-	-	-	8	207
Total	237	752(14)	14	153	19	149	270	1,054(14)

Table 2c. Number of sightings for all species observed in the entire research area by each stratum. Parentheses indicate the number of calves observed.

Species	Northern stratum		Southern stratum		Total	
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Blue whale	-	-	4	4	4	4
Fin whale	76	116(5)	38	53(4)	114	169(9)
Sei whale	2	4	79	147(6)	81	151(6)
Common minke whale	1	1	1	1	2	2
North Pacific right whale	1	1	-	-	1	1
Humpback whale	7	7	-	-	7	7
Sperm whale	17	24	28	28	45	52
Cuvier's beaked whale	-	-	1	4	1	4
Stejneger's beaked whale	-	-	2	8	2	8
<i>Mesoplodon</i> spp.	2	5	1	4	3	9
Ziphiidae	9	15	13	27	22	42
Killer whale	8	22	4	20(1)	12	42(1)
Risso's dolphin	-	-	1	16	1	16
Common dolphin	-	-	2	105(3)	2	105(3)
Pacific white-sided dolphin	1	7	2	20	3	27
Northern right whale dolphin	-	-	1	10	1	10
Dalli-type Dall's porpoise	48	177(1)	44	296	92	473(1)
Unid. type Dall's porpoise	20	71	15	57	35	128
Unid. large whale	18	23	26	47	44	70
Unid. dolphin/porpoise	-	-	8	207	8	207
Unid. whale	1	1	-	-	1	1
Total	211	474(6)	270	1,054(14)	481	1,528(20)

Table 2d. Number of sightings for all species observed in 2012, including sighting during transits and in the research area (R.A.). Parentheses indicate the number of calves observed.

Species	Transit to R.A.		Research Area (R.A.)		Transit from R.A.		Total	
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Blue whale	-	-	4	4	-	-	4	4
Fin whale	35	41(1)	114	169(9)	-	-	149	210(10)
Sei whale	6	13(1)	81	151(6)	-	-	87	164(7)
Common minke whale	-	-	2	2	-	-	2	2
North Pacific right whale	-	-	1	1	-	-	1	1
Humpback whale	14	26(1)	7	7	-	-	21	33(1)
Sperm whale	5	5	45	52	-	-	50	57
Baird's beaked whale	1	6	-	-	-	-	1	6
Cuvier's beaked whale	-	-	1	4	-	-	1	4
Stejneger's beaked whale	-	-	2	8	-	-	2	8
Mesoplodon spp.	-	-	3	9	-	-	3	9
Ziphiidae	1	2	22	42	-	-	23	44
Killer whale	5	57(6)	12	42(1)	-	-	17	99(7)
Risso's dolphin	-	-	1	16	-	-	1	16
Common dolphin	1	30	2	105(3)	-	-	3	135(3)
Pacific white-sided dolphin	-	-	3	27	-	-	3	27
Northern right whale dolphin	-	-	1	10	-	-	1	10
Dalli-type Dall's porpoise	1	8	92	473(1)	-	-	93	481(1)
Unid. Type Dall's porpoise	4	27	35	128	-	-	39	155
Unid. large whale	15	23	44	70	-	-	59	93
Unid. dolphin/porpoise	1	30	8	207	-	-	9	237
Unid. whale	-	-	1	1	-	-	1	1
Total	89	268(9)	481	1,528(20)			570	1,796(29)

Table 3. Minimum, maximum and range of sea surface temperatures in degrees Celsius for each species sighted during the cruise (including transit survey), sorted in order of frequency of sightings. Range of 25th to 75th quartiles are presented for fin, sei, humpback, sperm and killer whales. See text for details.

Species	Number of sightings	Minimum SST	Maximum SST	Temperature range	25th to 75th Quartile
Fin whale	149	7.8	22.5	14.7	10.3-13.2
Dalli-type Dall's porpoise	93	10	16.2	6.2	-
Sei whale	87	7.8	22.5	14.7	14.5-18.9
Sperm whale	50	7.7	20.6	12.9	11.7-14.0
Unidentified type Dall's porpoise	39	9.4	19.1	9.7	-
Ziphiidae	23	10.1	21.4	11.3	-
Humpback whale	21	8.5	12.6	4.1	8.6-10.5
Killer whale	17	9.2	19	9.8	10.3-13.6
Blue whale	4	11.2	16.2	5	-
Mesoplodon spp.	3	12.8	18.9	6.1	-
Common dolphin	3	19.1	21.7	2.6	-
Pacific white-sided dolphin	3	13.1	14.2	1.1	-
Common minke whale	2	13.4	14.1	0.7	-
Stejneger's beaked whale	2	17.8	20.4	2.6	-
North Pacific right whale	1	10.1	10.1	0	-
Northern right whale dolphin	1	13.6	13.6	0	-
Baird's beaked whale	1	11.2	11.2	0	-
Cuvier's beaked whale	1	13.9	13.9	0	-
Risso's dolphin	1	21.4	21.4	0	-

Table 4. Summary of the photo-identification experiment with accompanying photo-ID data. LD: Left dorsal; LL: Left lateral; RD: Right dorsal; RL: Right lateral. YS3 Whale ID numbers have been assigned to blue, humpback and sei whales. Biopsy sample numbers have been added to the whale ID numbers when a sampled whale was photo-identified. Temporary pod ID numbers have been assigned to killer whales. The fin whale photo data have been evaluated for photo-ID but not catalogued yet, so the fin whale ID numbers contain the biopsy sample number and an uppercase "X" in place of the catalogue number.

Common Name	Sighting Date	Sighting Number	Group size	Number of individuals photographed	YS3 Whale ID	Photo-ID result	Encounter Duration
North Pacific Right Whale	24-Jul-12	8	1	1	2012_Right_1	Right Head, Left Head, Top Head	24
Blue whale	18-Aug-12	1	1	1	2012_Blue_1_12061042	LD, LL/RD, RL	20
Blue whale	23-Aug-12	10	1	1	2012_Blue_2_12061047	LD,LL/RL	44
Blue whale	29-Aug-12	4	1	1	2012_Blue_3	RD/RL	44
Blue whale	29-Aug-12	13	1	1	2012_Blue_4	LD, LL/RL	46
Fin whale	20-Jul-12	2	2	2		RD of one, LD of the other	2
Fin whale	20-Jul-12	6	2	1		RD mother	5
Fin whale	20-Jul-12	11	2	2		2 LD	9
Fin whale	20-Jul-12	13	1	1		RD	5
Fin whale	20-Jul-12	15	1	1		LD	1
Fin whale	22-Jul-12	3	2	1		RD	0
Fin whale	23-Jul-12	6	1	1		RD	1
Fin whale	25-Jul-12	8	1	1		LD	3
Fin whale	25-Jul-12	9	2	1		LD	1
Fin whale	25-Jul-12	26	1	1		RD	0
Fin whale	25-Jul-12	28	1	1		RD	0
Fin whale	26-Jul-12	7	3	1		RD	5
Fin whale	26-Jul-12	11	1	1		RD	0
Fin whale	26-Jul-12	19	1	1		LD	1
Fin whale	26-Jul-12	26	1	1		RD	1
Fin whale	27-Jul-12	4	4	2		2 RD	6
Fin whale	28-Jul-12	7	2	2		LD/RD mother; RD calf	5
Fin whale	28-Jul-12	10	3	1		LD/RD	10
Fin whale	29-Jul-12	2	1	1		RD	8
Fin whale	29-Jul-12	11	2	1		RD	4
Fin whale	29-Jul-12	18	1	1		LD/RD	1
Fin whale	29-Jul-12	19	2	2		RD mother; RD calf	8
Fin whale	29-Jul-12	23	1	1		LD	2
Fin whale	29-Jul-12	30	1	1		RD	2
Fin whale	29-Jul-12	32	1	1		LD	1
Fin whale	29-Jul-12	33	2	2		2 LD	7
Fin whale	30-Jul-12	6	4	3		3 RD	31
Fin whale	30-Jul-12	7	2	1		RD	0
Fin whale	30-Jul-12	19	4	2		LD of one, RD of the other	8
Fin whale	30-Jul-12	27	3	1		LD	5
Fin whale	30-Jul-12	30	1	1		LD	4
Fin whale	31-Jul-12	14	1	1		LD	5
Fin whale	31-Jul-12	21	2	2		2 RD	6
Fin whale	03-Aug-12	3	3	2		RD mother; RD calf	21

Common Name	Sighting Date	Sighting Number	Group size	Number of individuals photographed	YS3 Whale ID	Photo-ID result	Encounter Duration
Fin whale	04-Aug-12	1	1	1		LD/RD	25
Fin whale	06-Aug-12	2	2	1		LD	23
Fin whale	09-Aug-12	7	1	1		RD	14
Fin whale	10-Aug-12	2	2	1	Fin_X_12051002	RD	57
Fin whale	10-Aug-12	9	2	1	Fin_X_12051006	LD	32
Fin whale	12-Aug-12	12	2	1		LD	18
Fin whale	15-Aug-12	8	1	1	Fin_X_12051031	LD	12
Fin whale	17-Aug-12	14	2	2	Fin_X_12051040 (mother)	RD mother, LD calf	23
Fin whale	20-Aug-12	22	1	1		RD, RL	
Fin whale	20-Aug-12	27	1	1		LD	1
Fin whale	27-Aug-12	2	2	2	Fin_X_12051049	2 LD	16
Fin whale	27-Aug-12	17	1	1		LD/RD	20
Fin whale	27-Aug-12	19	3	1	Fin_X_12051050	RD	28
Fin whale	29-Aug-12	17	1	1		RD	0
Sei whale	15-Jul-12	7	2	1	2012_Sei_1	LD	3
Sei whale	18-Jul-12	7	1	1	2012_Sei_2	LL	6
Sei whale	20-Jul-12	4	2	1	2012_Sei_3	RD	6
Sei whale	20-Jul-12	8	6	2	2012_Sei_4 (mother), 2012_Sei_5 (calf)	LD/RD mother; LD calf	20
Sei whale	02-Aug-12	3	1	1	2012_Sei_6	LD/RD	13
Sei whale	03-Aug-12	2	3	2	2012_Sei_7, 2012_Sei_8	2 RL/2 RD	21
Sei whale	05-Aug-12	3	1	1	2012_Sei_9	LD/RD	5
Sei whale	08-Aug-12	2	4	1	2012_Sei_10	LD	
Sei whale	09-Aug-12	2	2	1	2012_Sei_11	RD	26
Sei whale	09-Aug-12	6	1	1	2012_Sei_12_12041001	LD	14
Sei whale	10-Aug-12	1	1	1	2012_Sei_13	LD/RD	15
Sei whale	10-Aug-12	10	1	1	2012_Sei_14_12041007	LD/RD	23
Sei whale	10-Aug-12	12	2	2	2012_Sei_15_12041009, 2012_Sei_16	RD of biopsied whale, LD of the other	25
Sei whale	10-Aug-12	13	2	1	2012_Sei_17_12041010	LD	3
Sei whale	10-Aug-12	14	4	2	2012_Sei_18_12041011, 2012_Sei_19_12041012	RD	12
Sei whale	10-Aug-12	16	1	1	2012_Sei_20_12041013	RD	7
Sei whale	10-Aug-12	17	4	2	2012_Sei_21, 2012_Sei_22_12041014	RD of biopsied whale, RD of the other	27
Sei whale	10-Aug-12	18	1	1	2012_Sei_23_12041015	LD	8
Sei whale	11-Aug-12	1	1	1	2012_Sei_24_12041016	LD	10
Sei whale	12-Aug-12	5	1	1	2012_Sei_25_12041018	LL, LD	6
Sei whale	12-Aug-12	6	5	2	2012_Sei_26_12041019, 2012_Sei_27_12041020	1 LL, 2 LD	7
Sei whale	12-Aug-12	8	3	1	2012_Sei_28_12041021	LD/RD	15
Sei whale	12-Aug-12	11	6	6	2012_Sei_29_12041022, 2012_Sei_30, 2012_Sei_31, 1 LD/RD, 1 LL/LD, 4 LD 2012_Sei_32, 2012_Sei_33, 2012_Sei_34		25
Sei whale	13-Aug-12	11	1	1	2012_Sei_35_12041026	RD	11
Sei whale	13-Aug-12	12	1	1	2012_Sei_36_12041027	LD	5
Sei whale	13-Aug-12	13	1	1	2012_Sei_37_12041028	LD,LL	8

Common Name	Sighting Date	Sighting Number	Group size	Number of individuals photographed	YS3 Whale ID	Photo-ID result	Encounter Duration
Sei whale	15-Aug-12	7	1	1	2012_Sei_38_12041030	LD/RD	12
Sei whale	15-Aug-12	10	3	1	2012_Sei_39	LD, LL/RD, RL	
Sei whale	16-Aug-12	4	1	1	2012_Sei_40_12041032	RD, RL	13
Sei whale	16-Aug-12	6	1	1	2012_Sei_41_12041034	RD, RL	11
Sei whale	16-Aug-12	12	2	1	Sei_X_12041035 (mother), 2012_Sei_42_12041036 (calf)	LD/RD of calf	17
Sei whale	16-Aug-12	17	6	4	2012_Sei_43_12041037, 2012_Sei_44, 2012_Sei_45, 2012_Sei_46	LD/RD, RL, RD/RL, RD	21
Sei whale	17-Aug-12	3	4	2	2012_Sei_47_12041038, 2012_Sei_48	2 RD, RL	12
Sei whale	17-Aug-12	9	8	1	Sei_X_12051039, 2012_Sei_49	RD, RL	25
Sei whale	20-Aug-12	5	1	1	2012_Sei_50	RD, RL	24
Sei whale	20-Aug-12	7	1	1	2012_Sei_51_12041043	RD	13
Humpback whale	21-Jul-12	1	1	1	2012_Mn_1	Tail	13
Humpback whale	22-Jul-12	2	1	1	2012_Mn_2	LD	13
Humpback whale	22-Jul-12	5	3	2	2012_Mn_3, 2012_Mn_4	1 LD/RD, 1 LD	16
Humpback whale	22-Jul-12	8	3	3	2012_Mn_5, 2012_Mn_6, 2012_Mn_7	Mn_5:LD/RD/Tail; Mn_6:LD/RD/Tail; Mn_7:RD	17
Humpback whale	22-Jul-12	9	5	4	2012_Mn_8, 2012_Mn_9, 2012_Mn_10, 2012_Mn_11	Mn_8:LD/Tail, Mn_9:RD/Tail, Mn_10:Tail, Mn_11:Tail	38
Humpback whale	22-Jul-12	10	2	2	2012_Mn_12 (calf), 2012_Mn_13 (mother)	2 RD	1
Humpback whale	22-Jul-12	12	1	1	2012_Mn_14	LD	15
Humpback whale	22-Jul-12	13	1	1	2012_Mn_15	Tail	14
Humpback whale	22-Jul-12	14	1	1	2012_Mn_16	Partial tail/LD/RD	3
Humpback whale	22-Jul-12	17	4	2	2012_Mn_17, 2012_Mn_18	Mn_17:LD/Tail, Mn_18: RD/Tail	37
Humpback whale	23-Jul-12	34	1	1	2012_Mn_19	Tail	23
Humpback whale	24-Jul-12	4	1	1	2012_Mn_20	Tail	6
Humpback whale	25-Jul-12	12	1	1	2012_Mn_21	Tail	3
Humpback whale	27-Jul-12	12	1	1	2012_Mn_22	Tail	14
Humpback whale	27-Jul-12	14	1	1	2012_Mn_23	Tail	13
Humpback whale	28-Jul-12	8	1	1	2012_Mn_24	Tail	21
Humpback whale	28-Jul-12	12	1	1	2012_Mn_25	Tail, Genitals	11
Humpback whale	29-Jul-12	7	1	1	2012_Mn_26	LD	19
Sperm whale	28-Jul-12	1	1	1		RD	1
Killer whale	15-Jul-12	3	23	14	2012_715_3_RD_1:: 2012_715_3_KW_RD_14 ,including 14 RD RD_2 (calf), RD_6 (mother), RD_11 (mother), RD_14 (mother)		8
Killer whale	18-Jul-12	2	1	1	2012_718_2_KW_1	LD/ RD	13
Killer whale	18-Jul-12	3	17	2	2012_718_3_KW_1, 2012_718_3_KW_2	2 LD	24
Killer whale	18-Jul-12	4	12	5	2012_718_4_KW_1 (mother), 2012_718_4_KW_2, 5 LD 2012_718_4_KW_3 (mother), 2012_718_4_KW_4 (calf), 2012_718_4_KW_5		4
Killer whale	25-Jul-12	14	1	1	2012_725_14_KW_1	LD	14
Killer whale	25-Jul-12	16	4	2	2012_725_16_KW_1, 2012_725_16_KW_RD_1	LD of one, RD of the other	7
Killer whale	25-Jul-12	17	3	1	2012_725_17_KW_RD_1	RD	3

Common Name	Sighting Date	Sighting Number	Group size	Number of individuals photographed	YS3 Whale ID	Photo-ID result	Encounter Duration
Killer whale	27-Jul-12	1	4	4	2012_727_1_KW_1, 2012_727_1_KW_2, 2012_727_1_KW_3, 2012_727_1_KW_4	2 LD/RD, 2 LD	8
Killer whale	27-Jul-12	16	4	4	2012_727_1_KW_1, 2012_727_1_KW_2, 2012_727_1_KW_3, 2012_727_1_KW_4	4 LD	8
Killer whale	02-Aug-12	2	3	3	2012_82_2_KW_1, 2012_82_2_KW_2, 2012_82_2_KW_3	3 LD/RD	14
Killer whale	09-Aug-12	3	2	2	2012_89_3_KW_1, 2012_89_3_KW_2	2 LD, including 1 top saddle patch	10
Killer whale	20-Aug-12	24	11	11	2012_820_24_KW_1::2012_820_24_KW_11; 2012_820_24_KW_RD_1_12271046	11 LD (3 RD - None linked to LD)	25
Killer whale	20-Aug-12	30	5	1	2012_820_30_KW_1	LD	14

Table 5a. Biopsy experiment durations by quartile for successful encounters (time to first hit, total time of encounter, n = 48), for encounters where shots were fired but no samples were obtained (n = 12) and for encounters where the biopsy team was on the bow deck but not shots were fired (n = 17)

Biopsy Encounter Duration in hours:minutes:seconds				
	Time to first hit	Total time, sample retrieved	No shot	Shots, no hits
Minimum time	0:02:42	0:03:55	0:03:39	0:05:00
25 th Quartile	0:05:47	0:10:42	0:15:48	0:12:14
Median time	0:09:30	0:14:26	0:24:20	0:17:03
75 th Quartile	0:16:26	0:24:32	0:32:51	0:22:20
Maximum time	0:54:12	0:57:53	0:44:33	1:05:27

Table 5b. Summary of the biopsy experiment

Common Name	Sighting Date	Sighting Number	YS3WhaleID	Sample 1	Sample 2	Number of samples	Number of shots	Number of hits	Encounter Duration
Blue whale	18-Aug-12	1	2012_Blue_1_12061042	12061042		1	2	1	20
Blue whale	23-Aug-12	10	2012_Blue_2_12061047	12061047		1	2	1	44
Blue whale	29-Aug-12	4	2012_Blue_3				0		44
Blue whale	29-Aug-12	13	2012_Blue_4				3	0	46
Fin whale	04-Aug-12	1					0		25
Fin whale	04-Aug-12	4					0		40
Fin whale	05-Aug-12	9					0		32
Fin whale	06-Aug-12	2					0		23
Fin whale	09-Aug-12	1					0		11
Fin whale	09-Aug-12	7					1	0	14
Fin whale	10-Aug-12	2	Fin_X_12051002	12051002		1	7	1	57
Fin whale	10-Aug-12	9	Fin_X_12051006	12051006		1	1	1	32

Common Name	Sighting Date	Sighting Number	YS3WhaleID	Sample 1	Sample 2	Number of samples	Number of shots	Number of hits	Encounter Duration
Fin whale	11-Aug-12	10					0		25
Fin whale	12-Aug-12	4	Fin_X_12051017	12051017		1	2	1	19
Fin whale	12-Aug-12	12					2	0	18
Fin whale	15-Aug-12	8	Fin_X_12051031	12051031		1	4	2	12
Fin whale	17-Aug-12	14	Fin_X_12051040 (mother)	12051040		1	4	1	23
Fin whale	20-Aug-12	9	Fin_X_12051044 (calf), Fin_X_12051045 (mother)	12051044	12051045	2	2	2	10
Fin whale	27-Aug-12	1	Fin_X_12051048	12051048		1	1	1	19
Fin whale	27-Aug-12	2	Fin_X_12051049	12051049		1	2	2	16
Fin whale	27-Aug-12	9					0		33
Fin whale	27-Aug-12	17					1	0	20
Fin whale	27-Aug-12	19	Fin_X_12051050	12051050		1	4	2	28
Fin whale	29-Aug-12	7	Fin_X_12051051	12051051		1	2	2	17
Fin whale	29-Aug-12	12	Fin_X_12051052	12051052		1	2	1	7
Sei whale	05-Aug-12	3	2012_Sei_9				2	0	5
Sei whale	09-Aug-12	2	2012_Sei_11				1	0	26
Sei whale	09-Aug-12	6	2012_Sei_12_12041001	12041001		1	3	1	14
Sei whale	09-Aug-12	9					0		33
Sei whale	10-Aug-12	1	2012_Sei_13				1	0	15
Sei whale	10-Aug-12	3	Sei_X_12041003	12041003		1	4	1	40
Sei whale	10-Aug-12	4	Sei_X_12041004	12041004		1	2	2	39
Sei whale	10-Aug-12	8	Sei_X_12041005	12041005		1	3	1	32
Sei whale	10-Aug-12	10	2012_Sei_14_12041007	12041007		1	4	2	23
Sei whale	10-Aug-12	11	Sei_X_12041008	12041008		1	2	1	11
Sei whale	10-Aug-12	12	2012_Sei_15_12041009, 2012_Sei_16	12041009		1	4	2	25
Sei whale	10-Aug-12	13	2012_Sei_17_12041010	12041010		1	2	1	3
Sei whale	10-Aug-12	14	2012_Sei_18_12041011, 2012_Sei_19_12041012	12041011	12041012	2	2	2	12

Common Name	Sighting Date	Sighting Number	YS3WhaleID	Sample 1	Sample 2	Number of samples	Number of shots	Number of hits	Encounter Duration
Sei whale	10-Aug-12	16	2012_Sei_20_12041013	12041013		1	2	1	7
Sei whale	10-Aug-12	17	2012_Sei_21, 2012_Sei_22_12041014	12041014		1	3	1	27
Sei whale	10-Aug-12	18	2012_Sei_23_12041015	12041015		1	2	1	8
Sei whale	11-Aug-12	1	2012_Sei_24_12041016	12041016		1	2	1	10
Sei whale	11-Aug-12	2					2	0	21
Sei whale	12-Aug-12	3					0		8
Sei whale	12-Aug-12	5	2012_Sei_25_12041018	12041018		1	2	2	6
Sei whale	12-Aug-12	6	2012_Sei_26_12041019, 2012_Sei_27_12041020	12041019	12041020	2	4	3	7
Sei whale	12-Aug-12	8	2012_Sei_28_12041021	12041021		1	3	1	15
Sei whale	12-Aug-12	10					0		23
Sei whale	12-Aug-12	11	2012_Sei_29_12041022, 2012_Sei_30, 2012_Sei_31, 2012_Sei_32, 2012_Sei_33, 2012_Sei_34	12041022		1	6	1	25
Sei whale	13-Aug-12	2	Sei_X_12041023	12041023		1	4	2	24
Sei whale	13-Aug-12	3					0		15
Sei whale	13-Aug-12	4					2	0	12
Sei whale	13-Aug-12	7	Sei_X_12041024	12041024		1	2	1	11
Sei whale	13-Aug-12	8	Sei_X_12041025	12041025		1	1	1	9
Sei whale	13-Aug-12	11	2012_Sei_35_12041026	12041026		1	3	2	11
Sei whale	13-Aug-12	12	2012_Sei_36_12041027	12041027		1	2	2	5
Sei whale	13-Aug-12	13	2012_Sei_37_12041028	12041028		1	2	1	8
Sei whale	13-Aug-12	15	Sei_X_12041029	12041029		1	1	1	11
Sei whale	15-Aug-12	7	2012_Sei_38_12041030	12041030		1	2	1	12
Sei whale	16-Aug-12	2					1	0	10
Sei whale	16-Aug-12	4	2012_Sei_40_12041032	12041032		1	2	2	13
Sei whale	16-Aug-12	5	Sei_X_12041033	12041033		1	2	1	10
Sei whale	16-Aug-12	6	2012_Sei_41_12041034	12041034		1	3	1	11

Common Name	Sighting Date	Sighting Number	YS3WhaleID	Sample 1	Sample 2	Number of samples	Number of shots	Number of hits	Encounter Duration
Sei whale	16-Aug-12	9					0		28
Sei whale	16-Aug-12	12	Sei_X_12041035 (mother), 2012_Sei_42_12041036 (calf)	12041035	12041036	2	3	3	17
Sei whale	16-Aug-12	14					3	0	5
Sei whale	16-Aug-12	17	2012_Sei_43_12041037, 2012_Sei_44, 2012_Sei_45, 2012_Sei_46	12041037		1	2	1	21
Sei whale	17-Aug-12	3	2012_Sei_47_12041038, 2012_Sei_48	12041038		1	2	1	12
Sei whale	17-Aug-12	6					1		5
Sei whale	17-Aug-12	9	Sei_X_12051039, 2012_Sei_49	12041039		1	3	1	25
Sei whale	17-Aug-12	12					0		3
Sei whale	17-Aug-12	16	Sei_X_12041041	12041041		1	2	2	6
Sei whale	20-Aug-12	1					0		24
Sei whale	20-Aug-12	5	2012_Sei_50				0		24
Sei whale	20-Aug-12	7	2012_Sei_51_12041043	12041043		1	3	2	13
Sei whale	20-Aug-12	16					0		9
Killer whale	20-Aug-12	24	2012_820_24_KW_1::2012_820_24_K W_11; 2012_820_24_KW_RD_1_12271046	12271046		1	2	1	25

Table 6a. Summary of marine debris observations sorted by frequency of occurrence. Some new descriptive codes were developed based on the types of debris observed during the 2011 and 2012 POWER cruises.

IWC Code	YS3 POWER Code	Marine Debris Code Definitions	Count
134	134	single fishing float, round	88
199	801	wooden log	32
148	148	styrofoam board, less than 1 square meter	15
136	136	wood plank or milled wood board	13
199	701	tire with or without rim	12
199	301	buoy	11
199	199	other, unidentified object	9
199	601	plastic bottle	8
135	135	clustered fishing floats (2-10 floats together)	8
199	605	fiberglass or plastic board or piece	6
199	401	glass ball	5
199	602	square box	5
199	901	metal container	5
199	302	ship bumper	3
199	501	life jacket	3
199	201	barrel	2
199	606	plastic sheet or other unknown plastic piece	1
199	609	plastic ball	1
199	610	plastic fishing basket	1
199	650	coiled line, synthetic	1
199	802	wood pallet	1
Total			230

Table 6b. Summary of debris by day on days where 5 or more items were observed. Debris observed from 25-27 July (n = 31) were seen near the northernmost point in the northern stratum. Debris observed from 13-17 August (n= 171) were near the southernmost point of the southern stratum (see text for details).

Date	manmade	natural
25-Jul-12	5	1
26-Jul-12	6	8
27-Jul-12	1	4
30-Jul-12	5	1
13-Aug-12	11	0
14-Aug-12	32	4
15-Aug-12	81	4
16-Aug-12	31	1
17-Aug-12	7	0

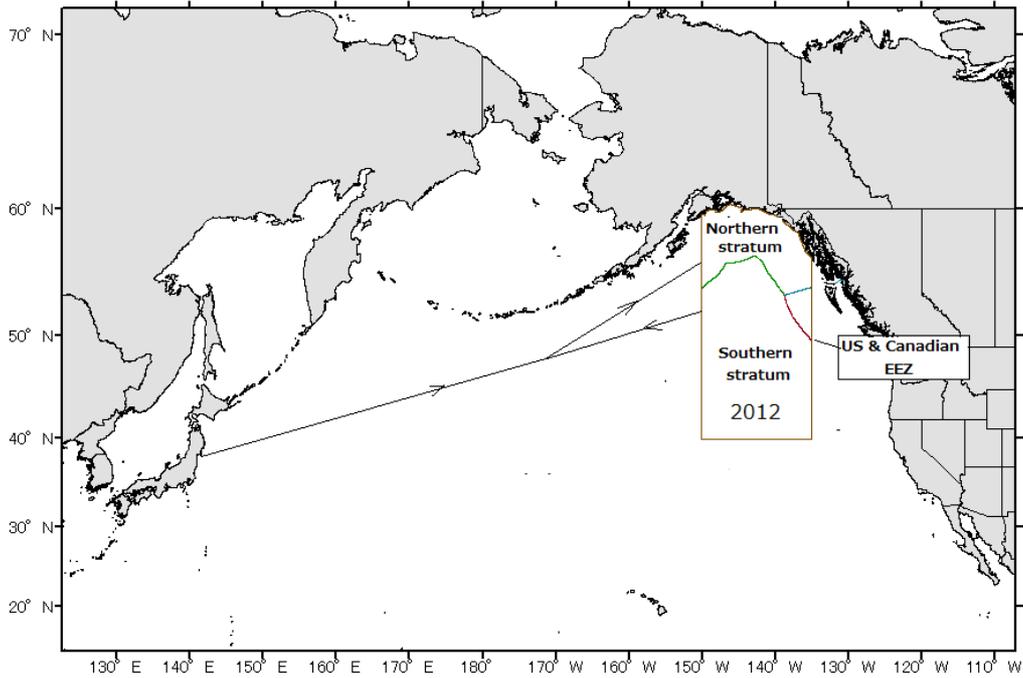


Figure 1a. Research area of the 2012 IWC-POWER cruise. The survey area is divided into northern and southern stratum at US and Canadian EEZ line. Outer limit of EEZ is provided by NOAA Office of Coast Survey and the data are available from http://www.nauticalcharts.noaa.gov/csdl/docs/GIS_EEZ_Alaska.zip.

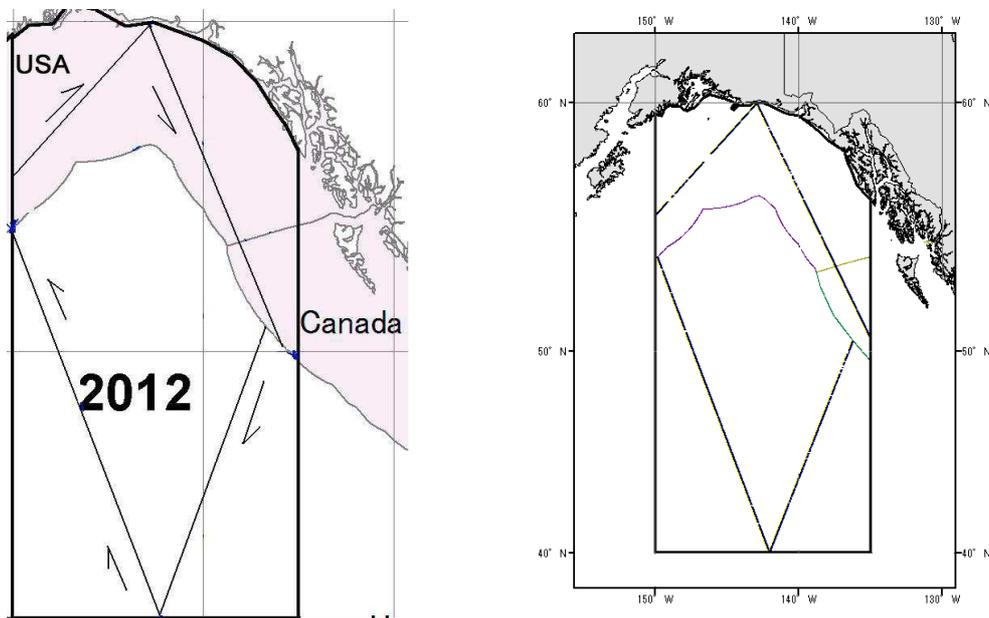


Figure 1b (left). The trackline design for 2012 cruise. The survey area is divided into northern and southern stratum at US and Canadian EEZ. Grey coloured area represents for the EEZ. The starting points of transect lines within the study area were randomized following IWC/SC guidelines (IWC, 2005).

Figure 1c (right). The searching effort of the 2012 IWC-POWER cruise (black line).

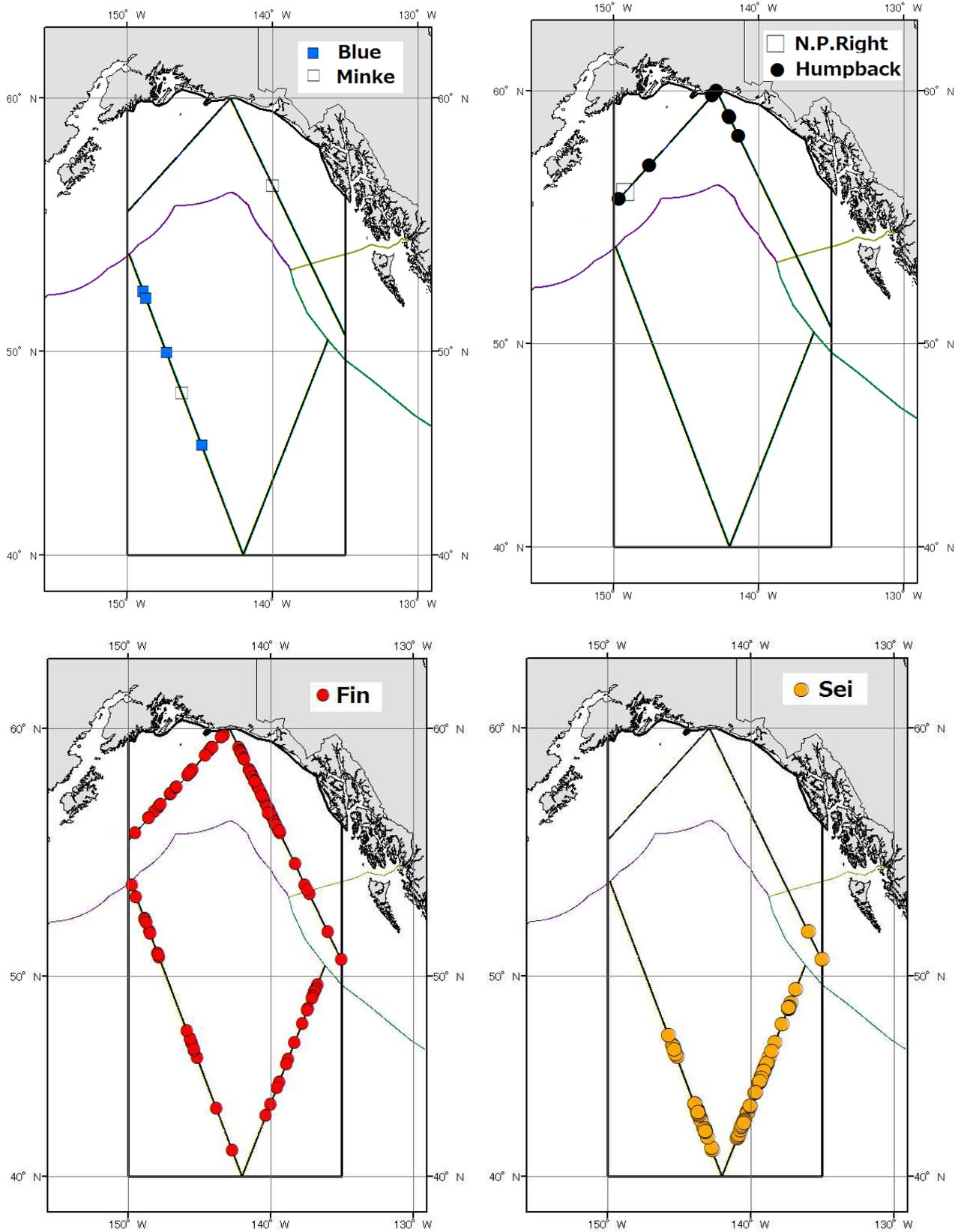


Figure 2a. Sighting positions of blue (blue square; top left), common minke (white square; top left), North Pacific right (white square; top right), humpback (black circle; top right), fin (red circle; bottom left), sei (orange circle; bottom right) whales in the research area.

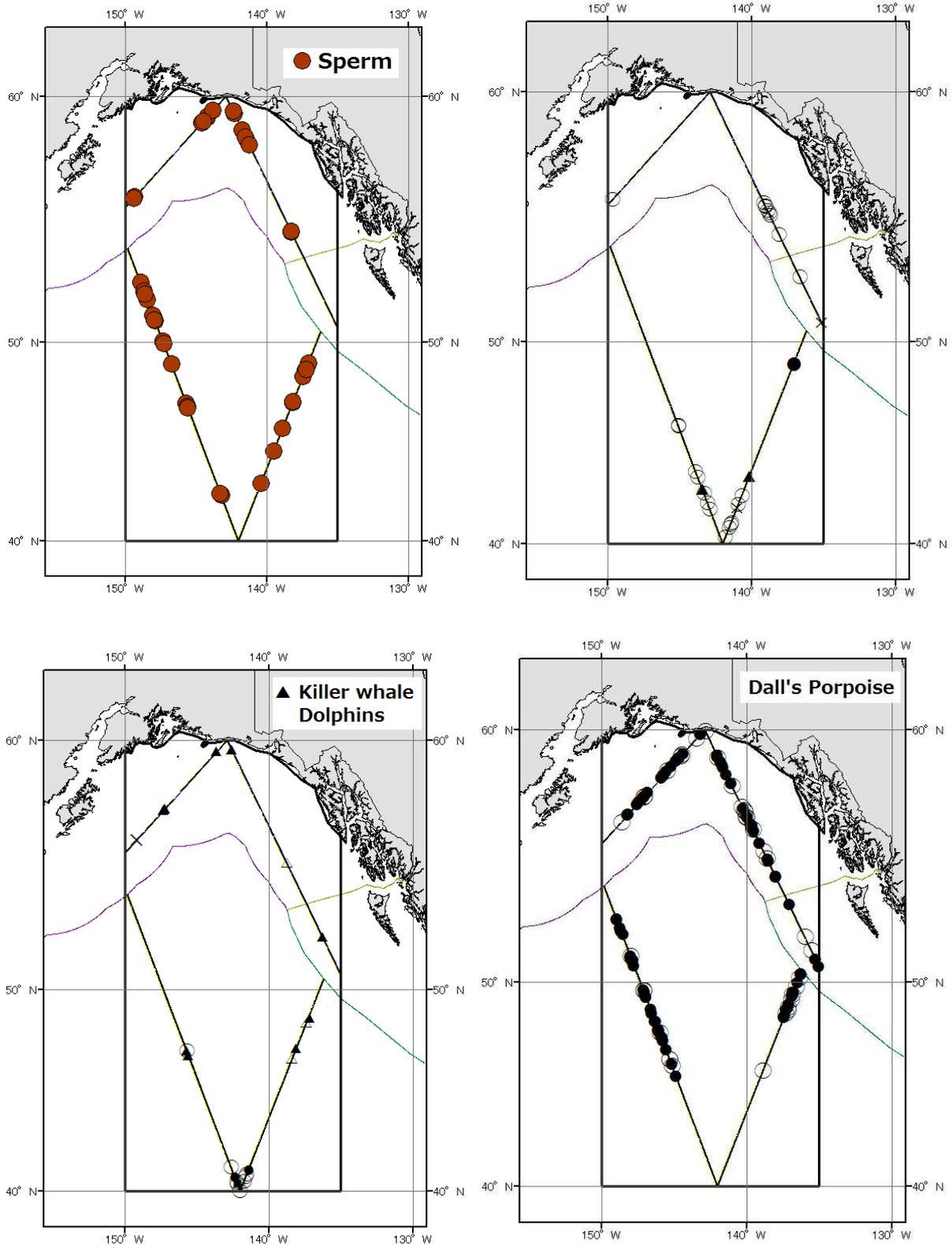


Figure 2b. Sighting positions of sperm (brown circle; top left), Cuvier's beaked (black circle; top right), Stejneger's beaked (cross; top right) whales, *Mesoplodon* spp. (black triangle; top right), Ziphiidae (white circle; top right), killer whale (black triangle; bottom left), common (black circle; bottom left), northern right (cross; bottom left), Pacific white-sided (white triangle; bottom left), Risso's (black square; bottom left), unidentified (white circle; bottom left) dolphins, Dalli type Dall's porpoise (black circle; bottom right), unid. type Dall's porpoise (white circle; bottom right) in the research area.

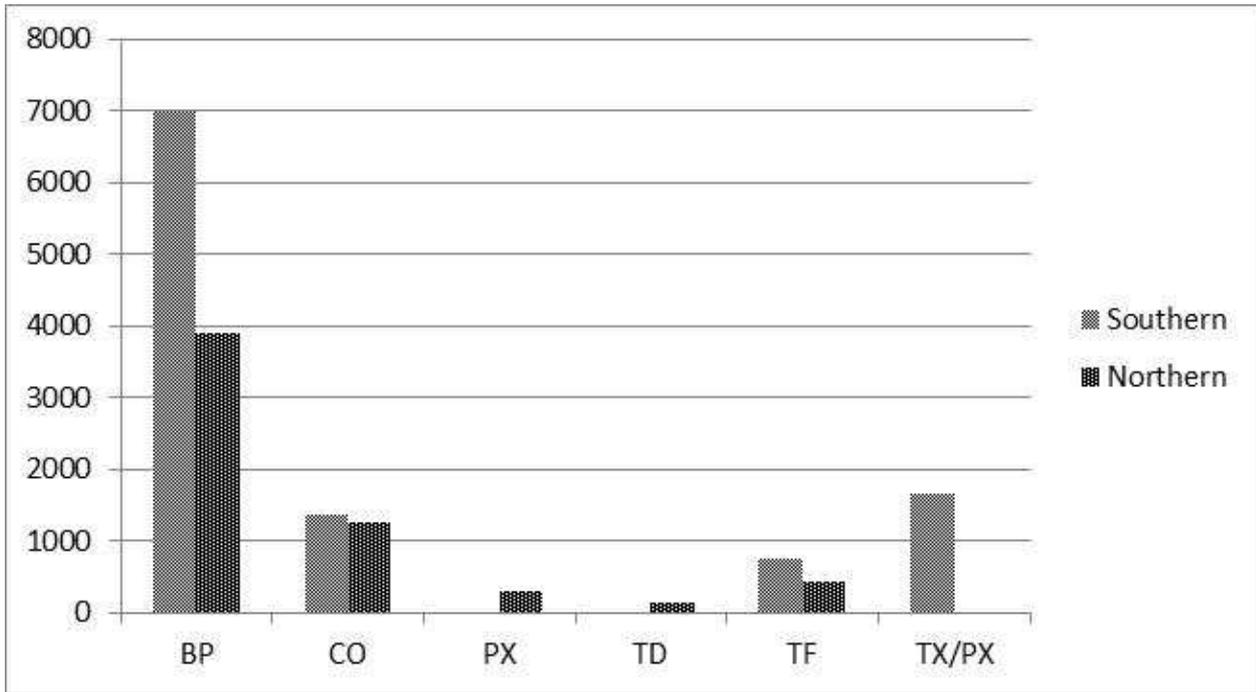


Figure 3. Breakdown of research time, in minutes, by effort mode for each stratum of the research area. Right side bar in each mode indicates the northern stratum. BP: Passing mode searching, CO: Confirmation of school, PX: Photo-ID experiment, TD: Top down steaming (off effort), TF: Time back to trackline, TX/PX: Biopsy experiment.

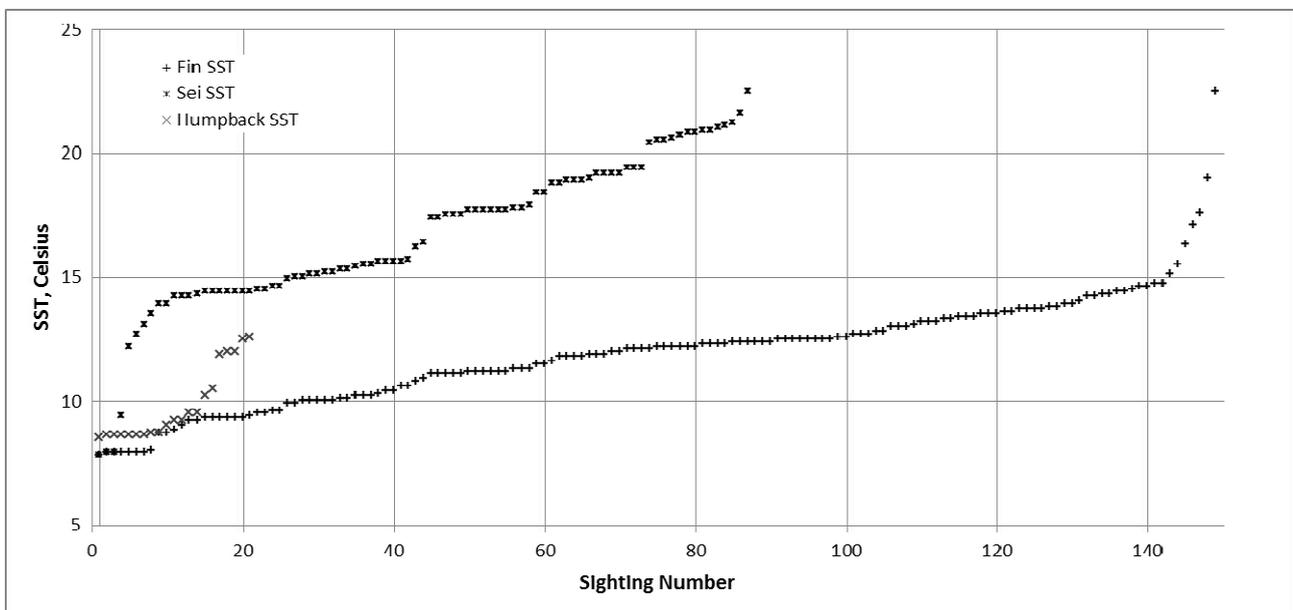


Figure 4. Sea surface temperatures for fin whales (149 sightings), sei whales (87 sightings) and humpback whales (21 sightings).

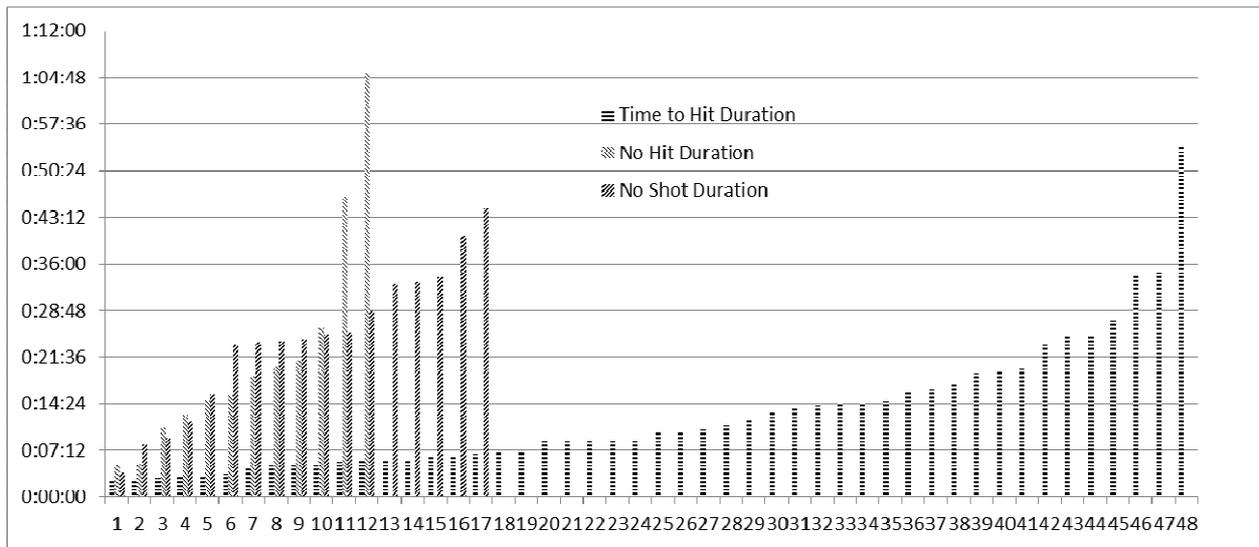


Figure 5a. Biopsy encounter times showing time to first hit (blue bars), duration of encounter when shots were fired but no samples were obtained (green bars), and duration of encounter when the biopsy team were on deck but no shots were fired (red bars).

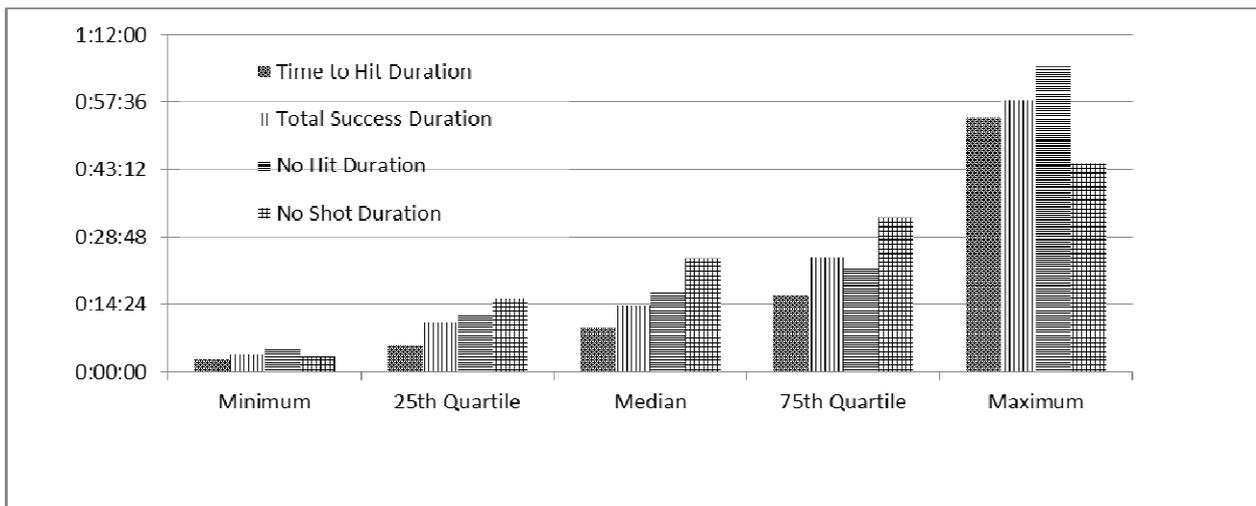


Figure 5b. Quartile analysis of biopsy encounter duration.

Appendix A

Ship specifications and crew list of *Yushin-Maru No.3*.

Ship photo:



Ship specifications:

	<i>Yushin-Maru No.3</i>
Call sign	7JCH
Length overall [m]	69.61
Molded breadth [m]	10.80
Gross tonnage (GT)	742
Barrel height [m]	19.5
Upper bridge height [m]	11.5
Bow height [m]	6.5
Engine power [PS / kW]	5280 / 3900

Crew list:

	<i>Yushin-Maru No.3</i>
Captain	K. Hirose
Chief Officer	H. Kasai
Second Officer	T. Koyanagi
Chief Engineer	Y. Murai
First Engineer	S. Miyamoto
Second Engineer	H. Fujimoto
Third Engineer	K. Takamatsu
Chief Operator	F. Iida
Boatswain	T. Ohmura
Quartermaster	K. Kuroki
Quartermaster	Y. Sekine
Quartermaster	K. Maehashi
Sailor	A. Tsuji
Sailor	A. Yamasaki
Sailor	S. Torihara
Chief Steward	S. Hamashita

Appendix B

Sightings in the US EEZ

1. DATES AND LOCATIONS OF SURVEY EFFORT IN US WATERS

The ship entered the US EEZ at location 48° 7.5' N, 177° 24.1 E on 19 July 2012 at approx. 12:53 SMT (GMT+12) and left the USEEZ and entered the Canadian EEZ at location 53° 42.7' N, 137° 21.8' W on 1 August at approx. 12:29 pm SMT (GMT +14.5). The ship re-entered US EEZ at location 53° 52.6' N, 150° 21.2' W after finishing surveys in the southern (high seas) stratum on 30 August at approx. 10:14pm SMT (GMT +13) and left USEEZ at location 47° 46.2' N, 179° 35.0' W on 3 Sept at approx. 11:07pm SMT (GMT+12).

The *Yushin-Maru No. 3* completed survey effort of approximately 295.54 nautical miles of trackline in the US EEZ during transit to the northern stratum and completed survey effort of approximately 578.97 nautical miles of trackline while surveying in US waters in the northern stratum.

2. SIGHTINGS AND PHOTO-ID IN US WATERS

Table 1 shows total sightings while in the US EEZ. Appendix Figures 2, 3a, 3b, 4, 6 and 7 show locations sightings of some of the species of note seen during surveys in US waters. One North Pacific right whale was observed and photo-identified (Appendix Figure 3b). Only three groups of sei whales were encountered in US waters (Table 1, Appendix Figure 3b). All sightings occurred within a one-hour period on 20 July during the transit survey to the research area south of the eastern Aleutians. One sighting was of a mother and calf which was part of a group of six sei whales and another sighting was of a group of two sei whales and the third sighting was a mixed group of one fin and one sei whale (Appendix Figure 1).

All sightings of humpback whales (21 groups) occurred in US waters (Appendix figure 3b). Fourteen sightings occurred during transit along the Aleutian trench and 7 sightings were in the northern stratum of the research area. Humpback whale group sizes during transit varied from 1 to 5. Humpback whale group sizes in the northern stratum were all solitary individuals. There was one off effort sighting of a humpback whale on 31 August as the ship returned to the USEEZ after finishing surveys in the southern stratum (Appendix Figure 3b). The sighting was not recorded in the sightings record because the sighting occurred at 05:38 outside of normal survey hours.

There were 6 pods of killer whales observed in US waters, including one pod that was seen twice in one day. Killer whale pod sightings were clustered with 3 pods seen on 25 July and 2 pods seen on 27 July. On 25 July, a lone male was seen 3.8 miles away from the second pod (a group of 4 whales) and seven miles from the third pod (3 whales). On 27 July one killer whale pod (group of 4 whales) was seen twice in one day. The group was encountered on the morning of 27 July on the way to the northernmost waypoint and seen again nine hours later, during the southbound survey, about 34 miles east of the original sighting location. The rate of travel of the pod was estimated to be 3.8 knots.

Fin whales were observed over a wide area both during transit and in the research area (Appendix Figure 2)

3. PHOTO-ID AND PHOTO DURATIONS

Photographic data were collected, sometimes opportunistically, in 93 encounters in the US EEZ. Photo-identification data were collected in 60 of the 93 encounters. While in the US EEZ, most encounter durations where photographs were taken were 20 minutes or less (25th to 75th quartile range: 6-20 minutes).

The longest photographic encounter duration was 38 minutes, documenting a group of 5 humpback whales. One individual was lob-tailing so the photo start time began a little earlier than usual (distant photographs of a the lob-tailing individual). The group was approached the group and tail flukes photographs were obtained of 4 of the 5 individuals.

The second longest photo encounter in the US EEZ was 37 minutes, a group of 4 humpback whales. The group split into 2 groups of 2 and tail flukes photographs were obtained of both whales in one of the subgroups of 2 whales. The third longest encounter duration was 31 minutes, a group of 4 fin whales "echelon" feeding (one whale trailing the other during feeding bouts) with Dall's porpoise feeding nearby.

Encounter duration for photo-documenting the North Pacific right whales was 24 minutes. Photo-identification photos were taken both from the bowdeck and from the barrel.

Table 1. Number of sightings for all species observed in the US EEZ by effort mode (NSP: Normal Passing with abeam closing Mode; BX: Begin experiment; OE: Off effort). Parentheses indicate the number of calves observed.

Species	NSP		BX		OE		Total	
	Sch.	Ind	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Fin whale	103	145(5)	1	1	3	4	107	150(5)
Sei whale	3	9(1)	-	-	-	-	3	9(1)
Common minke whale	1	1	-	-	-	-	1	1
North Pacific right whale	1	1	-	-	-	-	1	1
Humpback whale	21	33(1)	-	-	-	-	21	33(1)
Sperm whale	19	26	-	-	-	-	19	26
Mesoplodon spp.	1	3	-	-	-	-	1	3
Ziphiidae	9	16	-	-	-	-	9	16
Killer whale	7	19	-	-	-	-	7	19
Pacific white-sided dolphin	1	7	-	-	-	-	1	7
Dalli-type Dall's porpoise	39	148	1	3	5	18(1)	45	169(1)
Unid. type Dall's porpoise	16	61	1	7	3	11	20	79
Unid. large whale	28	37	2	6	1	1	31	44
Unid. whale	1	1	-	-	-	-	1	1
Total	250	507(1)	5	17	12	34(1)	267	558(8)

Appendix C

REPORT OF OF SURVEYS IN THE CANADIAN EEZ

1. DATES AND LOCATIONS OF SURVEY EFFORT IN CANADIAN WATERS

The *Yushin-Mar* No. 3 entered the Canadian EEZ at location 53° 42.7' N, 137° 21.8' W on 1 August 2012; 12:30 PM Ship Mean Time (SMT) (UTC +14.5, UTC Date Time: 7/31/2012; 10:00:00 PM) and finished surveys in the Canadian EEZ on 3 August 2012; 7:50 AM SMT (UTC + 14.5, UTC Date Time: 8/2/2012; 5:20:00 PM) after completing survey effort of approximately 188.6 nautical miles of trackline while in Canadian waters

The *Yushin-Mar* No. 3 exited the Canadian EEZ at location 50° 27.9 N and 136° 11.5 W, at 11:40 AM SMT (UTC + 14.5, UTC Date Time: 8/2/2012; 9:10:00 PM).

2. TOTAL SIGHTINGS IN CANADIAN WATERS

There were 14 sightings but only 10 sighting events during surveys in Canadian waters because of sightings of mixed groups of whales (Tables 1a and 1b).

There was one sighting of a killer whale pod composed of three individuals. One killer whale was seen and photographed with a piece of dead mammal in its mouth. Based on visual observations the prey was possibly a Dall's porpoise, but species of prey could not be confirmed positively. All three killer whales were photo-identified (left and right sides, *Yushin-Mar* No. 3 (YS3) ID numbers: 2012_82_2_KW_1, 2012_82_2_KW_2, 2012_82_2_KW_3).

There were three different sightings of fin whales, including a sighting of a fin whale mother and calf (during Sighting Event 10 on Table 1b). The first fin whale sighting was a solitary whale which was not approached for photography.

The two other fin whale sightings were in association with two sightings of sei whales. In the first sighting of fin and sei whales (Sighting Event 5 on Table 1b), the fin and sei whales appeared to be closely associated, surfacing together like conspecifics.

In the second fin and sei whale encounter (Event 10), both species were feeding near each other but there did not appear to be a close association between the fin and sei whales. The fin whale mother and calf were documented during Event 10.

Dall's porpoise were seen on 6 occasions (4 sightings of Dall's-type and 2 sightings of unknown type). Dall's porpoise were feeding in the vicinity of the mixed fin and sei whales both times (Events 5 and 10) and 2 sightings of sei whales (Table 1b).

An unknown type Ziphiid-type beaked whale was seen from a distance (Event 3) and a mesoplodont-type beaked whale was seen at a somewhat closer distance and some inconclusive photographs were taken (Event 9) (Table 1b).

3. APPROACHES FOR PHOTO-IDENTIFICATION

Photo-identification approaches occurred on three different occasions. The killer whale group was photographed over a period of 14 minutes, the first fin and sei mixed group was photographed over a period of 13 minutes, and the second fin and sei mixed group was photographed over a period of 21 minutes.

Table 1a. Number of sightings for all species observed in the Canadian EEZ by effort mode (NSP: Normal Passing with abeam closing Mode; BX: Begin experiment; OE: Off effort). Parentheses indicate the number of calves observed.

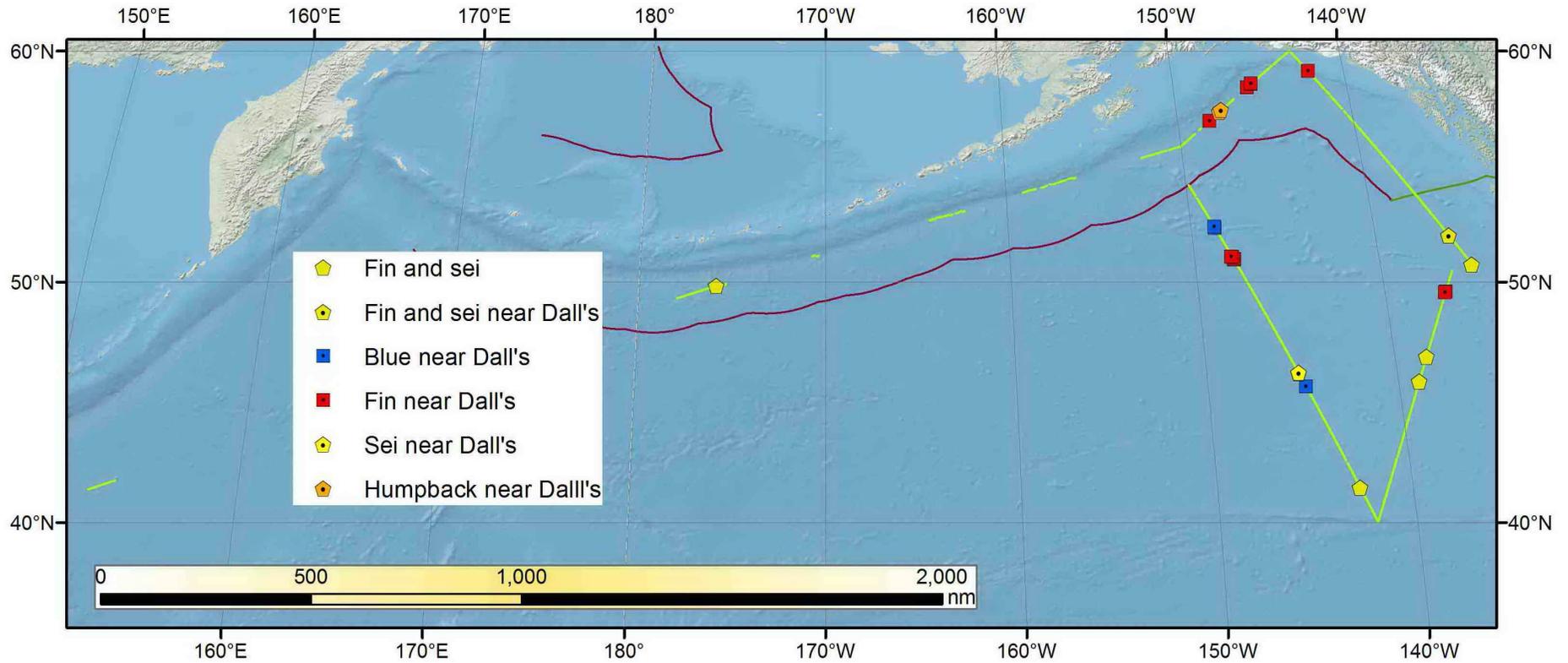
Species	NSP		BX		OE		Total	
	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.	Sch.	Ind.
Fin whale	3	6(1)	-	-	-	-	3	6(1)
Sei whale	2	4	-	-	-	-	2	4
Mesoplodon spp.	1	2	-	-	-	-	1	2
Ziphiidae	1	1	-	-	-	-	1	1
Killer whale	1	3	-	-	-	-	1	3
Dalli-type Dall's porpoise	4	16	-	-	-	-	4	16
Unid. type Dall's porpoise	2	3	-	-	-	-	2	3
Total	14	35(1)	-	-	-	-	14	35(1)

Table 1b. Details of all sightings in the Canadian EEZ, including locations, photo effort and duration of encounter.

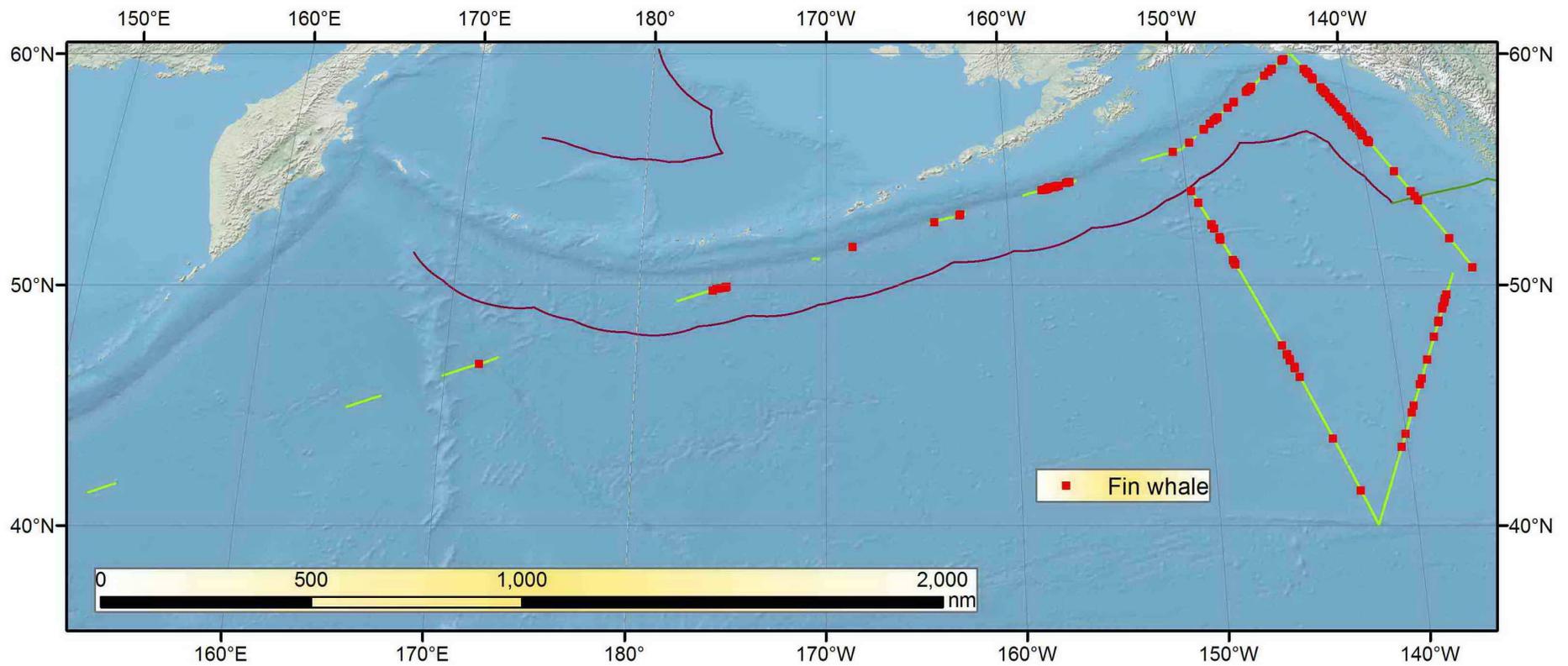
Sighting Event	Common Name	Sighting Date	Sighting Time	Sighting Number	Best estimate of group size	Encounter Duration (minutes)	Photo Start	Photo End	Reaction	Lat Deg	Lat Min	Lat NS	Long Deg	Long Min	Long EW
1	Fin whale	01-Aug-12	1:08:38 PM	2	1				No close approach	53	35.75	N	137	16.08	W
2	Dalli-type Dall's porpoise	01-Aug-12	3:06:21 PM	3	2				No approach	53	19.54	N	137	3.2	W
3	Ziphiidae, unknown species	02-Aug-12	6:19:17 AM	1	1				No approach	52	48.77	N	136	38.63	W
4	Killer whale	02-Aug-12	9:09:46 AM	2	3	14	9:17:22 AM	9:31:40 AM	No reaction	52	18.26	N	136	14.61	W
Mixed group of fin and sei whales with Dall's porpoise feeding nearby. Fin and sei whales were surfacing together like conspecifics															
	Sei whale	02-Aug-12	11:27:36 AM	3	1	13	12:05:19 PM	12:18:38 PM	No reaction	51	57.97	N	135	58.6	W
5	Fin whale	02-Aug-12	11:27:37 AM	4	2	13	12:05:19 PM	12:18:38 PM	No reaction	51	57.98	N	135	58.61	W
	Unidentified type Dall's porpoise	02-Aug-12	11:27:38 AM	5	2				No approach	51	57.98	N	135	58.61	W
6	Unidentified type Dall's porpoise	02-Aug-12	3:18:10 PM	6	1				No approach	51	22.04	N	135	31.03	W
7	Dalli-type Dall's porpoise	02-Aug-12	5:21:27 PM	7	4				No approach	50	59.92	N	135	14.16	W
8	Dalli-type Dall's porpoise	02-Aug-12	5:28:14 PM	8	7				No approach	50	58.75	N	135	13.2	W
9	Mesoplodon spp.	03-Aug-12	6:27:03 AM	1	2	0	6:28:02 AM	6:28:17 AM	No approach	50	51.03	N	135	7.38	W
Fin and sei whales and Dall's porpoise feeding near each other															
	Sei whale	03-Aug-12	7:06:51 AM	2	3	21	7:28:47 AM	7:50:08 AM	No reaction	50	44.17	N	135	2.23	W
10	Fin whale	03-Aug-12	7:06:52 AM	3	3	21	7:28:47 AM	7:50:08 AM	No reaction	50	44.17	N	135	2.23	W
	Dalli-type Dall's porpoise	03-Aug-12	7:26:59 AM	4	3				No approach	50	40.29	N	135	2.97	W

Appendix D

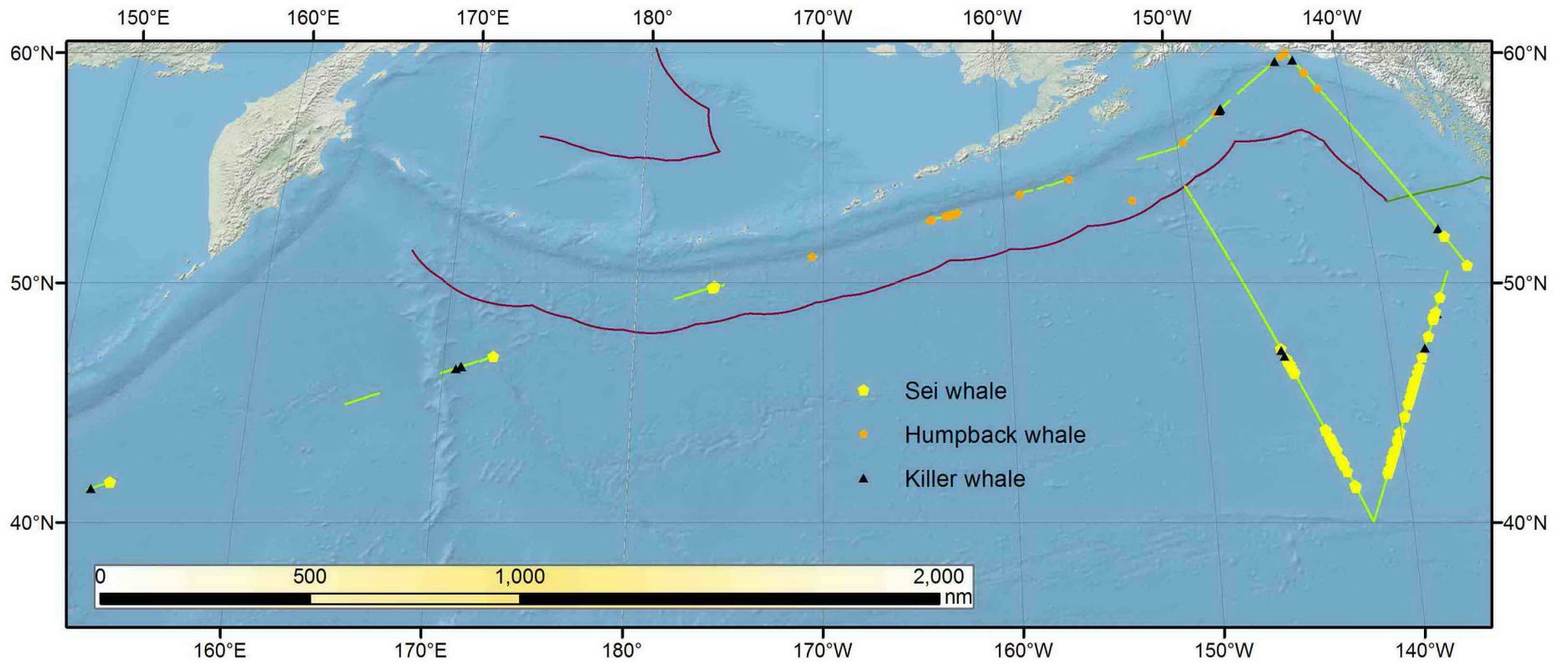
ADDITIONAL MAPS OF 2012-IWC-POWER SIGHTINGS



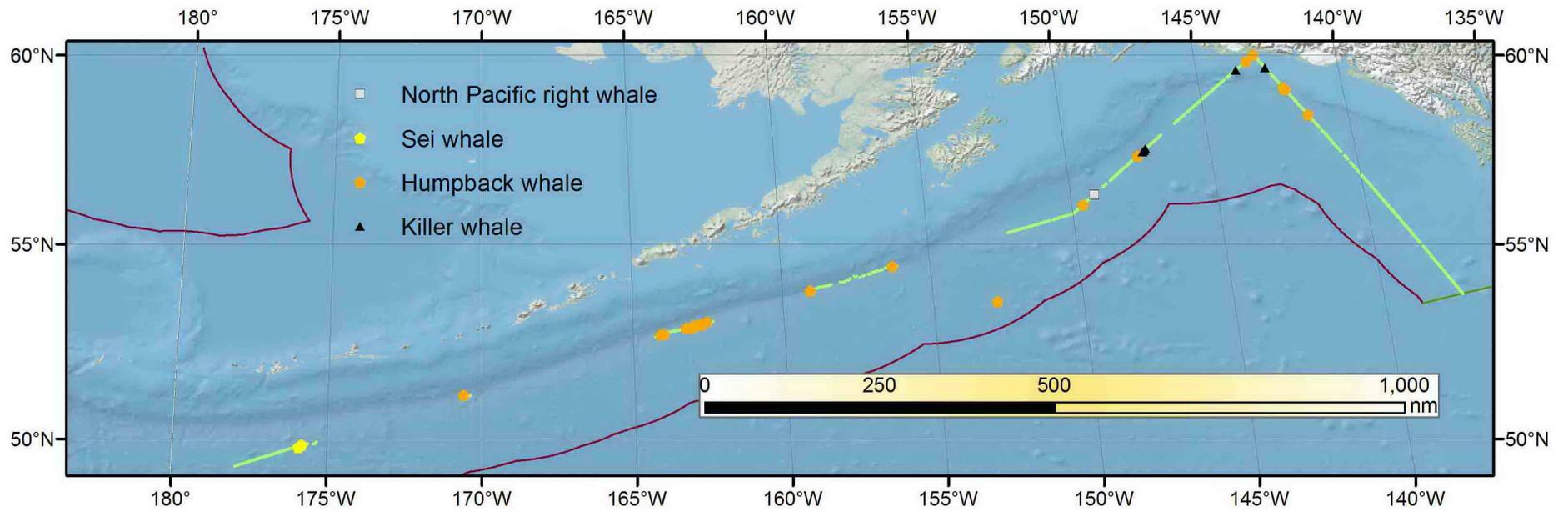
Appendix Figure 1. Locations of mixed groups of whales



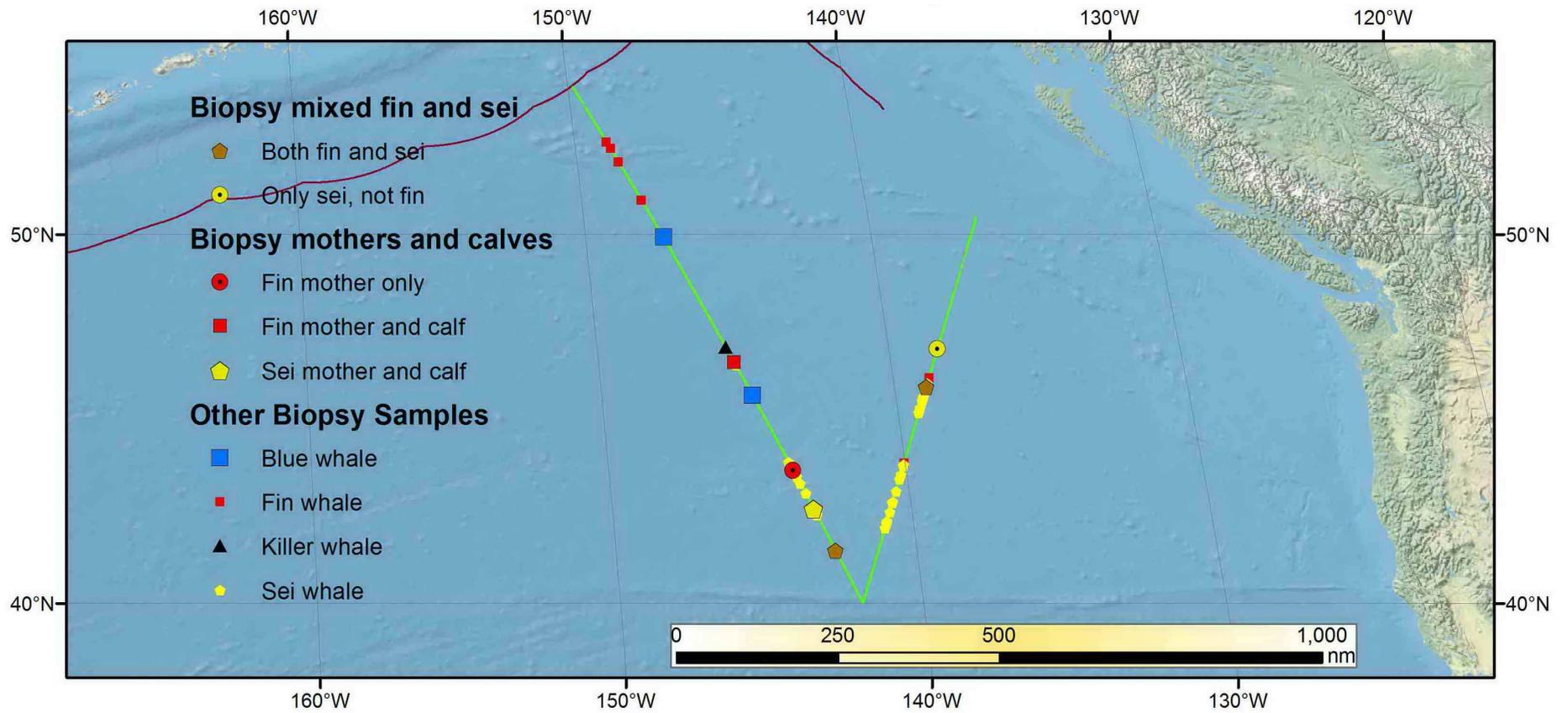
Appendix Figure 2. Locations of fin whales



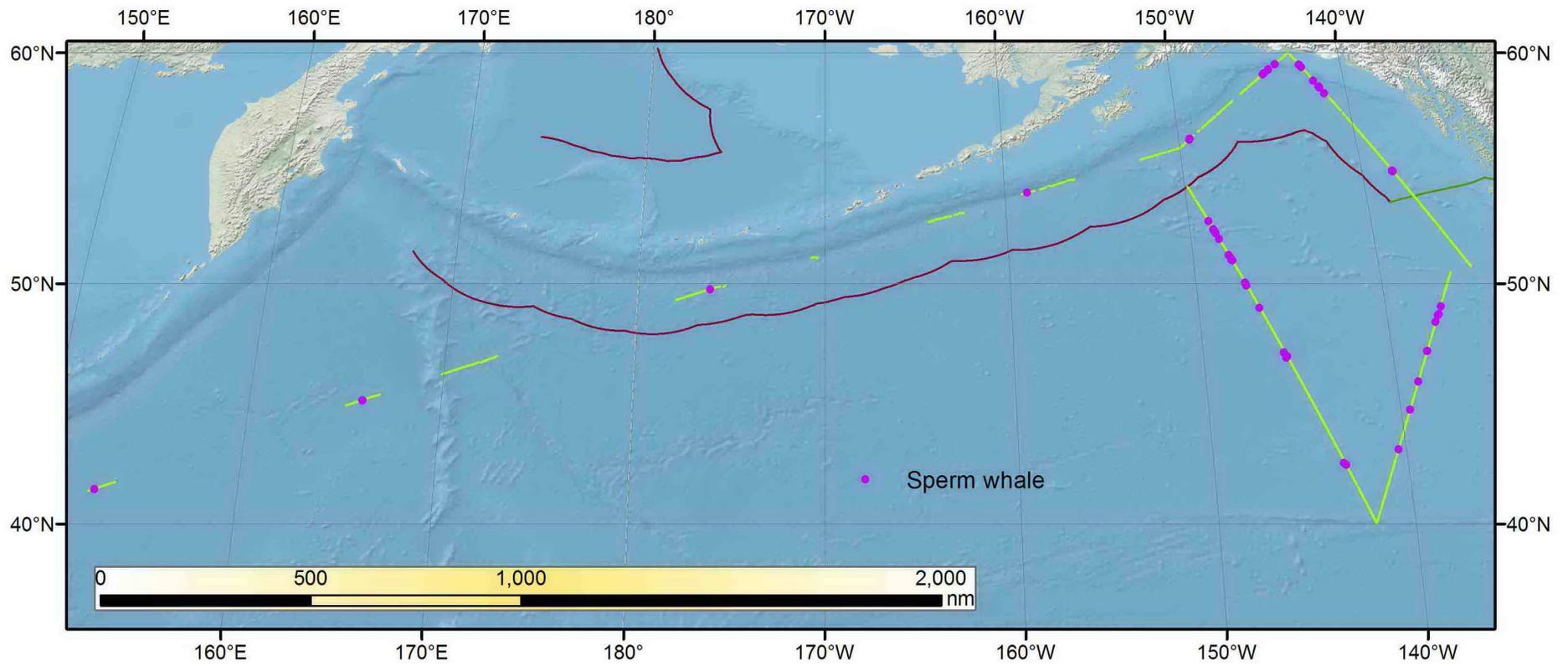
Appendix Figure 3a. Locations of humpback, sei and killer whales (all sightings)



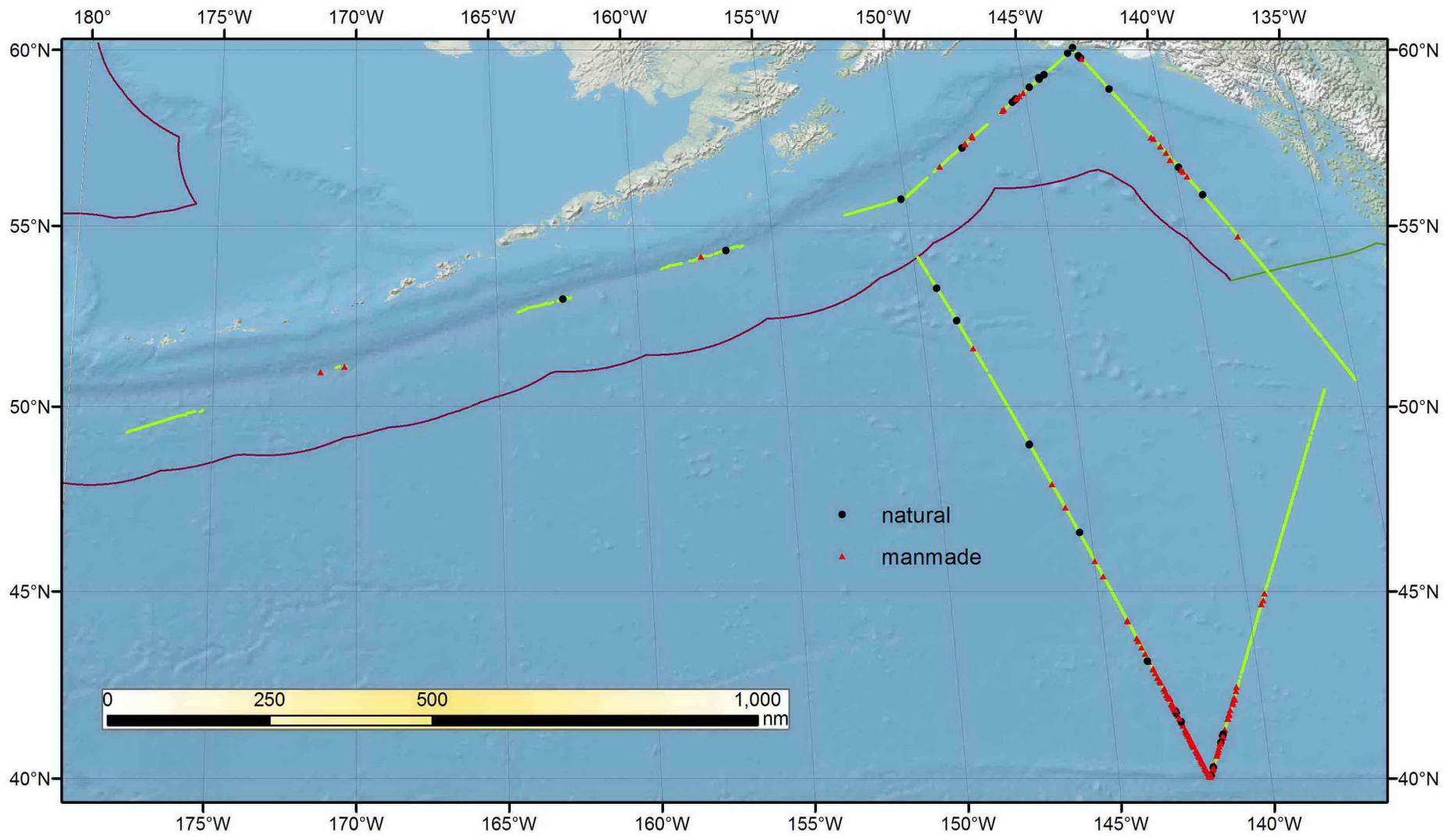
Appendix Figure 3b. Locations of North Pacific right, humpback, sei and killer whales in the USEEZ



Appendix Figure 5. Locations of biopsy sampling



Appendix Figure 6. Locations of sperm whales



Appendix Figure 7. Locations of marine debris